AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Response to the ERA's AR5 draft decision

31 May 2019

Additional information to support AEMO's 2019-22 allowable revenue and forecast capital expenditure proposal

Important notice

PURPOSE

AEMO has prepared this submission in response to the Economic Regulation Authority's (ERA) Draft Decision on AEMO's Allowable Revenue and Forecast Capital Expenditure 2019-20 to 2021-22 (referred to as the AR5 period), which was published on 8 May 2019. This submission addresses issues raised by the ERA in its draft decision, and where possible, provides additional information or clarity on aspects of AEMO's 15 March 2019 allowable revenue proposal. In this submission, AEMO has also sought to address feedback from market participants and stakeholders who lodged public submission in response to the ERA's 20 March issues paper on AEMO's allowable revenue submission.

The purpose of this submission is to help ensure the ERA has sufficient information to be able to make a more fully informed final decision of allowable revenue and capital expenditure for the AR5 period.

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VERSION CONTROL

Version	Release date	Changes
#1.0	24/5/2019	Draft copy for stakeholders.
#1.1	31/5/2019	Final copy submitted to ERA. Minor edits to improve clarity and grammar. Some additional commentary on the digital roadmap program of work.

Executive summary

Introduction

This document is AEMO's response to the Economic Regulation Authority's (ERA) draft decision on allowable revenue and forecast capital expenditure for the AR5 period (1 July 2019 to 30 June 2022). In this submission, AEMO responds to each aspect of the draft decision, and where possible, provides additional information to address issues raised by the ERA and demonstrate that AEMO's expenditure forecasts satisfy the requirements of clause 2.22A.11(a) and (b) of the Wholesale Electricity Market (WEM) Rules (and the corresponding GSI Rules).

AEMO would like to acknowledge that the ERA has included a draft decision stage for this AR5 determination. The WEM Rules do not require the ERA to publish a draft decision during its allowable revenue review process. AEMO welcomes this additional step, as it provides greater visibility of the decision-making process, and allows AEMO and market participants more input into the revenue and expenditure determination for what is a time of rapid change in the Western Australian (WA) energy sector.

The draft decision demonstrates alignment between the ERA and AEMO on a number of issues. The ERA has approved AEMO's proposed allowable revenue in principle, and the accounting principles and forecast operating costs have been generally accepted.

The main area of difference between the draft decision and AEMO's proposal relates to forecast capital expenditure. The approved amount of forecast capital expenditure in the ERA's draft decision does not enable AEMO to fulfil its WEM reform obligations under clause 1.20. Further, the ERA's draft decision does not include any forecast costs for the WA component of AEMO's digital roadmap. The digital roadmap is a foundational investment designed to uplift the entire organisation's technology platforms, which are old and need replacing. It is AEMO's view that without sufficient investment in its technology, AEMO's ability to perform its functions and obligations under the WEM Rules will be compromised.

The ERA has outlined additional evidence it requires for the forecast to be approvable under the WEM Rules with respect to the 'lowest practicably sustainable cost' requirement of clause 2.22A.11(b). AEMO is endeavouring to provide this information. However, AEMO considers the ERA must also have regard to clause 2.22A.11(a), which provides that allowable revenue[1] must be sufficient to cover the forward-looking costs of providing services described in clause 2.22A.1 and performing AEMO's functions and obligations under the WEM Rules.

AEMO welcomes the ERA's cooperative approach during the review process and believes the ERA's willingness to engage on key topics is reflected in the level of detail provided in the draft decision (noting the tight turnaround time), particularly with regard to WEM reform. In relation to the State Government's WEM reform program, AEMO maintains its view that approving a forecast capex amount to cover the costs of this program of work for the full AR5 period will result in a more efficient outcome – and provides further evidence to support this view in section 2.2.4 of this submission.

Proceeding with a staged funding approach as outlined in the draft decision will result in higher costs (e.g. in-period submission costs and project inefficiencies). It also duplicates AEMO's own governance practices by adding a layer of ERA oversight on in-period capital project management. The aim of the allowable revenue and forecast capital expenditure review process is to determine a forecast for the review period, and AEMO's role is to work within that forecast. There are mechanisms within the regulatory framework to adjust fees for

[1] Forecast capital expenditure is recovered via depreciation and amortisation costs, which form part of allowable revenue in AR5 and in future periods.

variations from that forecast, and all of AEMO's capital investment is subject to strict annual budget controls. Participants only pay for costs incurred rather than the revenue approved. AEMO therefore submits that in-period re-forecasting and approval of capital projects by the ERA is an inhibitive and inefficient activity.

The WA State Government's WEM reform program has been one of the most scrutinised aspects of the AR5 proposal - by both the ERA and market participants. The Minister for Energy has reaffirmed his commitment to WEM reform and has restated AEMO's obligation to support the reform and the importance that the program be fully funded.[2] WEM reform has therefore been the topic of a large proportion of the ERA's engagement with AEMO.

AEMO welcomes a similar level of engagement and information sharing with the ERA on any other aspects of the AR5 proposal and draft decision (for example the digital roadmap and treatment of contingency) to help the ERA inform itself that its final decision satisfies the requirements of the WEM Rules and the WEM objectives.

AEMO maintains that, subject to adjustments for contingency and projects no longer required, the allowable revenue and forecast capital expenditure proposed in its 15 March 2019 submission[3] is prudent, efficient, and satisfies the requirements of the WEM rules and objectives. AEMO requests the ERA revisits its position on requiring a staged capital expenditure approval process for WEM reform and that it considers the additional information provided by AEMO on capital requirements before making its final decision.

AEMO's position on the key aspects of the ERA's draft decision are discussed further below.

Allowable revenue and forecast capital expenditure

AEMO welcomes the ERA's draft decision to approve AEMO's WEM and Gas Services Information (GSI) allowable revenue in principle, and has provided additional information to the ERA to clarify some outstanding points on final resource estimates and the treatment of borrowing costs. AEMO will continue to work with the ERA to provide further information necessary to enable the ERA to satisfy itself that the allowable revenue forecast satisfies the various tests under the WEM and GSI rules.

With regard to forecast capital expenditure, AEMO has updated its capital forecast for the AR5 period based on the most up-to-date view of project scope and contingency requirements. As a result, AEMO has modified the forecast capital expenditure amount to $79.5 million. This is an $1.1 million increase compared with the initial submission.

The increase is due to a recent change by the International Accounting Standards Board (IASB) to the accounting treatment for leasing arrangements (which results in a $4.1 million[4] reallocation of operating costs to capital costs), and inclusion of $1.4 million for known and/or expected Rule Changes, as recommended by market participants and the ERA. These increases are offset by decreases in contingency requirements for projects, the removal of the e-terra 3.2 upgrade project[5], a reduction in baseline WEM reform cost estimate, and a significant scaling back of the AR5 requirements for the identity and access management project.

AEMO maintains that the three-year capital expenditure requirements for WEM reform and the digital roadmap are prudent, achieve the lowest practicably sustainable costs, and ensure allowable revenue is sufficient to cover the forward-looking costs of providing services. As recommended by market participants and the ERA, AEMO has provided additional information on these major programs – particularly the digital roadmap – to help inform the ERA's final forecast capital expenditure determination.

The changes in forecast capital requirements will have limited impact on allowable revenue and WEM fees for the AR5 period, as most of the capital costs will not be recovered until the AR6 period (2022-23 to 2024-25). The ERA's deliberations on the AR5 forecast capital expenditure remain ongoing, therefore a revised revenue

[2] Hon Bill Johnston MLA, public submission on the AR5 review process, available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations

[3] Hereon referred to as the initial submission.

[4] Note there is a net zero impact on allowable revenue requirements as it is move from direct to indirect costs.

[5] AEMO is now implementing e-terra 3.2 directly as part of the Power System Operations Project, so there is no need for the upgrade from e-terra v2.5.

calculation will be provided to the ERA prior to its final decision[6], which will reflect the ERA's required changes at that time.

WEM reform

The ERA has approved an amount of forecast capital expenditure (excluding contingency) to fund activities during the first year of WEM reform, plus funding for AEMO's WEM reform core team for the full three years. The ERA has not approved implementation costs for years two and three of the AR5 period, preferring a staged approach to funding approval.

If the ERA maintains this position in its final decision, though the approved forecast capital expenditure would enable AEMO to deliver tranche 1 of the WEM reform program, AEMO would not have sufficient resources available to deliver tranche 2.

AEMO maintains its view that approving funding for the full three years would be a more prudent and efficient course of action, and a staged approach would result in higher overall costs. There are four key reasons for this:

1. AEMO faces efficiency losses due to the risks of not attracting appropriately skilled internal recruits and/or the imposition of risk premiums by external vendors (potential increase of $2.2 million).
2. There are direct costs incurred by AEMO (and the ERA) in the development of and engagement on supplementary capital expenditure submissions (~$0.17 million additional AEMO costs for a supplementary submission).
3. The risk of delays (e.g. while teams await funding certainty) leads to direct cost increases because fixed cost resources are utilised for a greater amount of time (potential increases of $0.75-$1.25 million).
4. Program delivery, and therefore benefits realisation, is at risk of delay as the focus of the WEM reform team is diverted to supplementary submissions and/or teams are required to wait for further funding certainty.

AEMO understands the ERA's and market participants' concerns regarding approving implementation costs at this early stage. However, AEMO believes a three-year determination on WEM reform is approvable and in AEMO's view meets the intent of the WEM Rules. A three-year forecast capital expenditure determination has also been signalled by the Minister for Energy as the most appropriate course of action.[7]

The allowable revenue and forecast capital expenditure review process is designed to approve a three-year forecast, arrived at on a reasonable basis, which will determine market fees for the period. Annual fee adjustment mechanisms exist to ensure market participants do not pay for services they do not receive and to correct for forecast error. In-period forecast capital expenditure adjustments add avoidable costs to the market and should be reserved for exceptional circumstances where a reasonable forecast is not achievable.

The top-down estimate of implementation costs for WEM reform, which has been provided to the ERA, was arrived at on a reasonable basis and represents the best possible forecast in the circumstances. Most importantly, the amount the ERA would approve is a forecast only. Actual costs will likely vary from the forecast, and the way the regulatory framework is designed means market participants will only pay for costs actually incurred. In addition, AEMO is obligated to continually operate in a prudent manner and has demonstrated throughout the AR4 period that it meets these requirements by minimising capital expenditure where appropriate and maintaining transparency with market participants.

AEMO also considers that making a three-year determination would better satisfy the requirement of clause 2.22A.11(a) of the WEM Rules. Implementing WEM reform is an additional function conferred on AEMO by clause 1.20.1 of the WEM Rules, and clause 1.20.4 deems WEM reform activities to be services provided by AEMO for the purposes of clause 2.22A.1. As it stands, the draft decision would not provide sufficient revenue

[6] The ERA's final decision is due by 14 June 2019. AEMO will provide a revised allowable revenue calculation to the ERA in advance of this.

[7] Hon Bill Johnston MLA, public submission on the AR5 review process, available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations

during the AR6 period to cover the capital costs of WEM reform, which AEMO is obligated to incur during AR5.

AEMO therefore submits approving the forecast capital expenditure for the full AR5 period would result in lower overall costs, is permissible under the WEM Rules, and recommends the ERA revisits its draft decision on this issue.

Digital roadmap

The ERA's draft decision is not to approve any digital roadmap funding at this stage. The ERA highlights that the digital roadmap program was introduced late in AEMO's AR5 preparation and detailed costs and benefits of the digital roadmap for WA's market and system management services have not been determined. AEMO is endeavouring to provide more information to help justify the AR5 digital roadmap forecast.

As with WEM reform, AEMO considers approving a full three-year capital forecast will result in the lowest practicably sustainable cost of delivering this work. This is because the funding certainty will enable AEMO to secure resources at a more competitive price and avoid the cost of making in-period submissions. In the case of the digital roadmap, it would also allow the WA components of this AEMO-wide uplift in IT capability to be delivered, and avoid a scenario where AEMO WA must implement disparate IT systems at a likely greater cost. AEMO therefore maintains that the $13.8 million[8] forecast should be approved by the ERA in its final decision.

The ERA recommends AEMO should *estimate the resources required to undertake more detailed scoping and planning for incorporating WEM and GSI requirements into the Australia-wide digital roadmap*, which should enable *...identification of the costs and benefits of the digital roadmap for the WEM and GSI, compared to developing a Western Australian specific digital roadmap...*[9]

AEMO will aim to provide as much information as possible on the benefits and scope of the WEM and GSI requirements in time to help inform the ERA's final decision on 14 June 2019. Given the tight time constraints, it is likely that any analysis provided to the ERA ahead of its final decision will be preliminary only. A further cost-benefit analysis will be used to inform actual expenditure and project delivery during the period, which will help promote prudent investment and ensure only efficient costs are recovered via allowable revenue.

AEMO has, however, identified a number of systems and applications in the digital roadmap that are used by the whole of AEMO as part of its everyday business activities, and are not specifically designed to deliver benefits to any particular market (e.g. WEM or GSI or the National Electricity Market (NEM)). AEMO submits that capital expenditure on such systems is prudent and the WEM contribution to upgrading these business systems can be approved in the final decision.

Like all businesses, AEMO relies on technology to enable its employees and market participants to communicate and work effectively. AEMO's technology is old and needs to be replaced. Business systems (such as web, data management and cyber security) are shared by the whole of AEMO, and it would be impractical and inefficient for AEMO to have disparate systems for its WA operations.

AEMO WA is essentially the Western Australian branch of AEMO. In order to function as part of one larger, more efficient entity, to the fullest extent possible AEMO WA should use the same business systems as the rest of the organisation. This was the vision when the decision was announced in September 2015 for the former Independent Market Operator (IMO) to be subsumed by AEMO. If AEMO WA is not able to pay for its share of the digital roadmap, then separate systems would have to be implemented in WA. As a much smaller business, it is unlikely AEMO WA would be able to achieve the same economies of scale or scope.

The costs and benefits of these AEMO-wide business systems have been considered as part of the broader digital roadmap program, and a high-level estimate has been provided to the ERA. However, because these systems are not NEM or WEM-specific, the benefits have not been explicitly called out by jurisdiction. The

[8] The WEM allocation is $13.0 million and $0.8. million to GSI.

[9] ERA, May 2018, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 37.

relative benefits of adopting enhanced cyber security would be the same in Victoria as it would be in Western Australia.

AEMO submits that the estimated benefits of the AEMO-wide business systems to the NEM are applicable to the WEM, and the capital forecasts are robust enough to enable the ERA to approve these costs in its final decision. AEMO therefore suggests that if the ERA considers it cannot approve the full three-year digital roadmap forecast after reviewing the additional information and justification provided, the ERA approves, as a minimum, forecast expenditure of ($4.8 million[10]) on the WA component of AEMO-wide business systems, which are scheduled for implementation in 2019-20.

Details of the AEMO-wide systems being implemented in the first year of the AR5 period and the scope of work is provided in section 2.2.4 of this submission.

Treatment of project contingency

In its capital expenditure forecast, AEMO has included amounts to cover project contingencies. These contingency amounts are provided to accommodate the risk that individual project scope, timing and costs might vary from forecast. These contingencies enable AEMO to deliver projects without the need to make additional in-period capital expenditure requests and incur the associated costs. It also helps avoid potential project delays that may arise if projects have to be placed on hold until additional funding is approved. The amount of contingency in AEMO's AR5 initial submission varies by project (from as little as 10% to as much as 56%), with most project contingency being around 30% of the project baseline cost.

Including project contingencies is standard project and program management practice, and the ERA has accepted inclusion of contingencies for capital projects in its past determinations. In its draft decision, the ERA has stated that further information is required on risks associated with each project and why individual project contingencies are necessary. This information is required so the ERA can satisfy itself that the forecast project costs meet the requirements of clause 2.22A.11(b).

AEMO has reviewed the contingent amounts for each project and has provided further risk-based justification. AEMO has applied the contingency methodology currently being assessed by AEMO's Project Management Office (PMO), which recommends the calculation of a risk-based contingency reserve (bottom-up) and application of a management reserve for unknowns (top-down).[11]

The contingency discussion is provided in section 2.2.1 of this submission. As a result of the risk-based review, the aggregated amount of project contingency has been adjusted and now comprises $14.8 million (19%) of the total forecast (down from $17.9 million). AEMO notes that these revised estimates do not include any top down management reserve but expects these may form part of project estimates for future submissions once this approach is embedded within standard AEMO practices. AEMO considers the additional information provided is consistent with that approved by the ERA in past determinations and justifies the inclusion of project contingency expenditure in the AR5 capital expenditure forecast.

Use of WEM Rule 2.22A.9

Rather than providing the additional risk-based justification per project, the ERA suggests an alternative option is to use the mechanism under clause 2.22A.9 of the WEM Rules, which provides for up to a 10% overspend in total forecast capital expenditure without the need for an in-period adjustment. AEMO does not consider this is a viable option. AEMO agrees with the ERA's position that contingency costs of known projects should be justified based on project risk. Using clause 2.22A.9 to accommodate project overspends without having to define risk would be an inappropriate use of the mechanism.

AEMO considers the purpose of clause 2.22A.9 is designed to accommodate minor operating or capital cost requirements that arise during an allowable revenue period, which could not be forecast when the allowable revenue proposal was made. It is not designed to accommodate individual contingencies on known projects

[10] WEM and GSI.

[11] This approach is consistent with accepted contingency/management reserve models - see https://www.pmi.org/learning/library/model-risk-contingency-reserve-9310 and https://4squareviews.com/2013/05/07/5th-edition-pmbok-guide-chapter-7-contingency-reserves-and-management-reserves/

(and nor would a 10% contingency be sufficient as per the evidence provided in the initial submission). Historically, AEMO has reserved the mechanism under 2.22A.9 for unbudgeted rule changes or similar costs that are unlikely to be significant but cannot be foreseen at the time of developing the expenditure forecast. AEMO also believes including individual project contingencies based on risk is important for transparency, as it provides a forecast of potential capital spend, which ultimately flows through to market fees.

Further, AEMO submits that including a separate contingent amount for each project meets the requirements of the WEM Rules. Approving a project contingency in the forecast means the avoidable costs of making an in-period expenditure adjustment are less likely to be incurred. This reflects the actions of a prudent operator seeking to achieve the lowest practicably sustainable cost of service. Including a project contingency does not necessarily mean the full contingent amounts will be spent. AEMO does not earn a return on its capital base and is an independent not-for-profit organisation, therefore it has no incentive to incur the full contingent amount. Only capital expenditure actually incurred will be recovered via allowable revenue, with the majority of costs recovered during the AR6 period (via recovery of depreciation costs). Market participants will only pay for services actually delivered, with market fees being adjusted accordingly.

Small scale and existing capital projects

In its draft decision, the ERA has adjusted the forecast capital expenditure for projects it categorises as already existing or small scale (i.e. projects that are not part of WEM reform or the digital roadmap). The ERA has made a downward adjustment totalling $6.2 million, with $2.8 million of this reduction due to its draft decision not to approve any project contingency amounts at this stage (as discussed above).

In addition to disallowing contingency, the ERA has not allowed funding where it considers *there is insufficient detail to:*

- *Justify the need for the project*
- *Explain how the project costs have been determined*
- *Demonstrate that the forecast is the lowest practicably sustainable cost.*[12]

AEMO has reviewed its forecast capital expenditure and maintains that, subject to adjustments for projects no longer required[13] and revised contingency amounts, the forecast put forward in its initial submission is prudent, efficient and capable of being approved under the WEM Rules. AEMO has therefore provided additional information to the ERA to justify the need for the projects and continues to work with the ERA's secretariat ahead of the final decision to provide further evidence to support the forecast.

GSI allowable revenue and capex

In its draft decision, the ERA considers AEMO's proposed GSI allowable revenue is reasonable and allowable revenue of $5.6 million is approved in principle.[14] AEMO welcomes this decision and continues to work with the ERA to finalise the operating expenditure requirements.

As with the WEM, the most significant variation between AEMO's GSI proposal and the ERA's draft decision is the forecast capital expenditure on the digital roadmap and project contingencies. AEMO's position on forecast capital requirements is outlined above, and equally applies to the GSI capital projects.

AEMO will adjust the final GSI allowable revenue as required prior to the ERA's final decision, pending the ERA's revised forecast capital expenditure position.

[12] ERA, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 18.

[13] e-terra upgrade and the majority of Tranche 1 identity and access management costs

[14] ERA, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 24.

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1. About this submission

This document is AEMO's response to the ERA's draft decision on allowable revenue and forecast capital expenditure for the AR5 period. It responds directly to the issues raised by the ERA in its draft decision and provides additional information to support AEMO's 15 March 2019 allowable revenue and forecast capital expenditure proposal (hereon referred to as the initial submission).

1.1 Structure of this document

This submission should be read in the context of the ERA's draft decision. To aid the reader, this submission broadly follows the structure of the ERA's draft decision document, addressing each aspect of the ERA's decision in the same order.

1.2 Public consultation process

This submission also includes an appendix that outlines AEMO's response to issues raised by market participants and interested stakeholders in the ERA's public consultation process. In many cases the issues raised in public submissions have either been addressed by the ERA in its draft decision or addressed by AEMO in the main body of this submission. Appendix A.1 is therefore designed to provide a transparent and useful summary of the issues raised and how these issues have been addressed.

AEMO welcomes further feedback on the AR5 proposal including meeting with any interested parties to discuss the proposal or the ERA's draft decision.

The ERA's final decision is due on Friday 14 June. AEMO will be hosting the next Western Australian Electricity Consultative Forum (WACEF) on Tuesday 25 June, where it will provide an overview of the final decision and what it means for the market and market reform over the AR5 period.

1.3 Values used in this submission

All financial information in this document are present in nominal dollars unless otherwise stated. Some tables may not sum due to rounding.

In the draft decision, the ERA recommends AEMO should update its CPI assumptions to align with the WA State Budget forward estimates. Given AEMO is a national organisation and to be consistent and efficient across the business, AEMO has decided to stay with the current proposed CPI assumption which is 2.1% (except for employee and accommodation costs).

2. Response to the ERA's draft decision

This section follows broadly the same structure as section 5 of the ERA's draft decision. In each section AEMO responds to the ERA's draft decision on each aspect of the AR5 proposal, and where relevant, provides additional information to address issues raised by the ERA or explains how AEMO recommends the issue could best be resolved. All amounts in this section are expressed in nominal dollars.

2.1 WEM allowable revenue

The ERA has approved AEMO's WEM allowable revenue in principle, pending further information on final resource estimates and the treatment of borrowing costs. This information has been provided to the ERA, and a summary of AEMO's position on each of the revenue cost categories is provided in the following sections.

Any changes in forecast capital requirements will have limited impact on allowable revenue and WEM fees for the AR5 period, as most of the capital costs will not be recovered until AR6. A revised allowable revenue calculation will be provided to the ERA prior to its final decision, which will reflect the ERA's required changes at that time.

2.1.1 Employee benefits

In its draft decision, the ERA has reviewed the full time equivalent (FTE) numbers for the proposed capital project schedules and is satisfied the year-on-year movements are reasonable. The ERA has used an averaging approach to test the reasonableness of employee benefits expenditure growth over the AR5 period and has approved the employee benefits forecast in principle.

Noting that different renumeration rates and benefits apply for different types of FTEs, AEMO has provided additional clarification to the ERA on forecast staffing levels and the combination of internal, contract and consulting staff during the AR5 period.

2.1.2 Accommodation costs

In its draft decision, the ERA is satisfied that the proposed accommodation costs for the AR5 period are reasonable for the current location and that AEMO has demonstrated the least cost accommodation option.[15] AEMO acknowledges the ERA suggestion that accommodation options outside the central business district (CBD) may be worth considering, and will include non-CBD locations in its options assessment if alternative accommodation needs arise in the future.

One required adjustment to revenue (and forecast capital expenditure) relates to leasing. The IASB has developed a new accounting standard that requires all leases to be recognised on an organisation's balance sheet, except for short-term leases and leases of low value assets. These changes were issued by the Australian Accounting Standards Board in February 2016 and are effective for periods beginning on or after 1 January 2019. As AEMO reports on a June fiscal year end, the application of the new standard is mandatory

[15] Ibid, page 15.

from 1 July 2019 for the 30 June 2020 reporting year. No retrospective adjustments will be made to leases for prior years.

The key impacts to AEMO are recognition of interest expense on the lease liability, and depreciation as a result of amortising the right of use asset on a straight-line basis in place of what would have previously been rental or lease expense. This results in the treatment of $3.9 million of lease expenses as capital rather than operating costs. The overall expense impact is neutral.

2.1.3 Supplies and services

AEMO's proposed supplies and services expenditure for AR5 is 29% lower than incurred during AR4. This is largely a result of ceasing the current service agreement with Western Power and taking full operational control and responsibility for system management systems.

The ERA has approved the AR5 supplies and services revenue forecast, recognising that bringing these systems in house has resulted in a lower overall reduction in supplies and services expenditure and is consistent with AEMO seeking least cost solutions.[16]

AEMO will continue to seek similar efficiencies over the longer term as it continues to integrate AEMO WA and its systems into the larger AEMO organisation.

2.1.4 Borrowing costs

As highlighted in the initial submission, AEMO will not recover any expensed interest on borrowing costs during the AR5 period. All borrowing costs planned for the AR5 period are directly attributed to capital projects greater than $1 million, and will therefore be capitalised and recovered as part of the depreciation schedule for those assets.

AEMO has provided further clarification on the AEMO's application of borrowing costs to the ERA. This included explanation on the benefits of AEMO's cashflow position (in comparison to the Independent Market Operator arrangements) and why there is no longer a requirement to secure debt to fund operational activities.

2.1.5 Depreciation

AEMO has applied the same depreciation approach for AR5 as it has for prior periods. AEMO commences recovery of depreciation costs in the year after the asset was placed in service. This means assets installed at the end of AR4 and during the first and second years of AR5 will commence depreciation during the AR5 period. In some cases, AEMO has accelerated depreciation where systems will be replaced as part of WEM reform.

The ERA considers this approach reasonable and is satisfied that the depreciation expenditure forecast for AR5 is consistent with standard business accounting practice.[17]

2.2 WEM forecast capital expenditure

In its draft decision, the ERA has reduced forecast capital expenditure by $56 million. This is largely due to the ERA:

- Approving only the first year of expenditure on WEM reform (plus three-years of core team costs).
- Excluding all forecast costs associated with the digital roadmap.
- Not approving any project contingency amounts.

[16] Ibid, page 15.

[17] Ibid, page 16.

- Not including forecast costs associated with some small-scale projects.

Currently, the ERA is proposing to approve $20.8 million of forecast capital expenditure, or 27% of what was proposed in AEMO's initial submission. The ERA has invited AEMO to provide additional or enhanced information in support of projects with disallowed funding.

AEMO has reviewed its forecast capital expenditure and maintains that, subject to adjustments for capital no longer required in AR5[18] and revised contingency amounts, the forecast put forward in its initial submission is prudent, efficient and capable of being approved under the WEM Rules. AEMO has provided additional information to the ERA and continues to work with the ERA ahead of the final decision to provide further evidence to support the forecast.

AEMO accepts that in some instances – particularly with regard to the digital roadmap – some projects are too early in their lifecycle to be able to provide significant additional detail and scope ahead of the ERA's final decision in June. However, AEMO maintains its view that a three-year determination for both WEM reform and digital roadmap activities would result in the lowest practicably sustainable cost of providing services.

In the case of the digital roadmap, AEMO has provided further information to justify investment in systems that relate to AEMO-wide business activities (i.e. not designed to deliver specific benefits to the WEM or NEM itself), which are scheduled to be delivered during the first year of the AR5 period. While AEMO submits that the full three-year ($13 million) forecast should be approved, AEMO recommends that as a minimum, it would be prudent and permissible under the WEM Rules to approve the 2019-20 costs of ($4.5 million[19]) for these business systems.

As recommended by the ERA and market participants, AEMO has also included a forecast capital expenditure amount to accommodate development and implementation of business-as-usual rule changes.

A summary of the revised capital expenditure forecast position is summarised in Table 1. To aid the reader, the table is structured as per Table 6 in the ERA's draft decision.

Table 1: Adjustments to forecast capital expenditure for the AR5 period ($,000 nominal)

WEM capital project	AEMO proposed	ERA draft decision	AEMO response	Rationale / justification
Existing projects				
Power System Operation	473	418	516	AEMO estimates contingency of 23% is required for this project. Additional risk-based justification is provided in section 2.2.2.
E-terra upgrade	687	-	-	AEMO will implement e-terra version 3.2 directly as part of its e-Terra establishment project.
System Management System Transition	2,209	1,703	2,215	AEMO estimates contingency of 30% is required for this project. Additional risk-based justification is provided in section 2.2.2.
Reduction of Prudential Exposure Phase 2	2,324	1,872	2,478	AEMO estimates contingency of 32% is required for this project. Additional risk-based justification is provided in section 2.2.2.
Sub-total existing projects	5,693	3,993	5,209	
New, small-scale projects				

[18] e-terra upgrade and the majority of tranche 1 identity and access management costs.

[19] WEM component.

WEM capital project	AEMO proposed	ERA draft decision	AEMO response	Rationale / justification
POMAX database and metering	1,036	946	997	AEMO estimates contingency of 8% is required for this project. Additional risk-based justification is provided in section 2.2.3
POMAX settlements replacement	1,597	1,132	1,521	AEMO estimates contingency of 37% is required for this project. Additional risk-based justification is provided in section 2.2.3.
Business continuity capability	498	-	229	AEMO has now selected a preferred option and provided a revised forecast to the ERA. Contingency of 15% is required for this project. See section 2.2.3.
STEM Fortran	469	-	448	The expected increase in market participants will see the Fortran language reach its limits during the AR5 period, meaning no additional participants could be incorporated after this point. Contingency of 24% is required for this project. See section 2.2.3.
Hardware and software lifecycle support	904	696	864	AEMO estimates contingency of 22% is required for this project. Additional risk-based justification is provided in section 2.2.3.
Enhanced control room tools	304	-	314	The required situational awareness tools will not be enabled through the WEM reform or digital roadmap. The proposed tools and current/emerging risks are discussed in section 2.2.3. Contingency of 34% is required for this project.
Demand and renewable energy forecasting	90	69	89	AEMO estimates contingency of 29% is required for this project. Additional risk-based justification is provided in section 2.2.3.
Market operator interface	420	-	363	Current issues with the interface during 2018 have led to out-merit-dispatch and non-compliance with WEM Rules. Detail on the frequency and consequence of risks if existing arrangements are maintained is provided in section 2.2.3. Contingency of 12% is required for this project.
PASA process improvement	216	-	209	The PASA review is complete. AEMO now has explicit scope of requirements and alternative options. Contingency of 26% is required for this project. See section 2.2.3.
System Management application remediation	406	-	402	Additional detail on the known issues with the SM systems, as well as the required enhancements is provided in section 2.2.3. Contingency of 29% is required for this project.
Spinning reserve cost allocation rule change	176	114	129	AEMO estimates contingency of 13% is required for this project. Additional risk-based justification is provided in section 2.2.3.
Administrative improvements to outage process rule change	408	-	759	Updated costings have been provided to the Rule Change Panel Support team. Contingency of 25% is required for this project. See section 2.2.3.
Identity and access management	1,045	112	112	The project is ahead of schedule during AR4, so the costs to be incurred during AR5 are lower than originally estimated. The original estimate also included some costs that were incorrectly attributed to WA. AEMO has since provided an updated forecast of $112,000 (WEM) for this work.

WEM capital project	AEMO proposed	ERA draft decision	AEMO response	Rationale / justification
				AEMO estimates no contingency is required for this project. Additional risk-based justification is provided in section 2.2.3.
Sub-total new small-scale projects	7,569	3,069	6,436	
Large-scale, early stage projects				
Digital roadmap	12,692	-	12,968[20]	AEMO maintains that the initial forecast is prudent and efficient, and a three-year determination would result in the lowest practicably sustainable cost. AEMO has provided further information to justify investment in systems that relate to AEMO-wide business activities (i.e. not designed to deliver specific benefits to the WEM or NEM itself), which are scheduled to be delivered during the first year of the AR5 period. AEMO recommends that as a minimum, it would be prudent and permissible under the WEM Rules to approve the 2019-20 costs of ($4.5 million) for these business systems. Contingency of 30% is required for this project. See section 2.2.4.
WEM reform	51,249	13,751	48,457	AEMO maintains its view that a three-year determination is more efficient and can be approved under the WEM rules. Contingency of 25% is required for this project. See section 2.2.4.
Sub-total large-scale, early stage projects	63,941	13,751	61,529	
Development and implementation of business-as-usual rule changes	-	-	1,420	As recommended by the ERA and market participants, AEMO has included a forecast capital expenditure amount to accommodate development and implementation of business-as-usual rule changes.
Accommodation	-	-	3,870	Due to new IASB accounting standard for treatment of leasing costs.
Total WEM forecast capital expenditure	**77,203**	**20,813**	**78,466**	

Further detail on AEMO's response on the treatment of contingencies and each of the capital projects listed in Table 1 is provided in the following sections.

2.2.1 Treatment of contingencies

As highlighted in the draft decision, the ERA has in previous determinations accepted the inclusion of contingencies for capital projects.[21] However, in its draft decision the ERA has not approved the proposed project contingencies in AEMO's AR5 capital expenditure forecast. This is because the ERA considers *the*

[20] Note this revised amount corrects for the appropriate WEM/GSI split of digital roadmap costs. The WEM/GSI split is 94/06. The initial proposal showed the split as 92/08.

[21] ERA, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 16.

information provided does not clearly demonstrate that contingencies have been applied to individual projects based on identified tangible risks.[22]

AEMO submits that the contingency amounts estimated in the initial submission are well-reasoned assessments of project contingency and are based on a consideration of the likely risk associated with each project. Though a 30% contingency is the starting point for consideration, the actual contingency put forward is varied based on project risk and the likelihood of that risk materialising.

However, AEMO respects the ERA's view that it requires further information in order to satisfy itself that any contingency amounts are prudent and justifiable under the WEM Rules. AEMO has therefore reviewed the contingency amounts attributed to each project and identified tangible risks. Where possible, AEMO has used additional information on project scope and risk (that was not available at the time of drafting the initial AR5 proposal) to better inform the contingency requirements and adjust the forecast accordingly.

AEMO applies a standard project risk assessment methodology to each capital program. The methodology requires each project manager to identify tangible risks that have the potential to occur during project delivery. To aid the risk assessment, the type of risks considered are categorised into two key elements:

- Resources – the risk that the estimated cost of resources to deliver the project will vary from forecast. This risk may vary depending on the availability of resources, requirements for specialist expertise due to increasing project complexity, or a potential change in project scope. The resources risk assessment is broken into three sub-elements:
    - Mix – risk that the estimated risk of internal vs external resources may vary.
    - Scope/effort – risk that the complexity or scope of the project may vary, leading to additional or specialist resources.
    - Other – any other feasible risks, such as exchange rate risk or other resourcing priorities emerging ahead of the proposed project.
- Platform – the risk that the estimated cost of hardware, software or licences associated with the project will vary from forecast. This risk may vary depending on the changing complexity of a project, or if there are interdependencies between projects that lead to additional or materially different platform requirements. The platform risk assessment has two sub-elements:
    - Scope/effort – the risk that the complexity or scope of the project may vary, leading to additional or new hardware/technology requirements.
    - Other – any other feasible risks such as the exchange rate risk (a common risk as hardware is often sourced from overseas), product availability, or changing compliance requirements/standards.

Once risks under these two categories have been identified, each risk is given a percentage assessment of the likelihood of that risk occurring (100% being certain to arise, 0% being no contingency necessary). These assessments are then used to inform the contingency requirement for each risk. A worked example is shown below.

[22] Ibid, page 17.

Figure 1: Worked example of project contingency calculation methodology

AR5 Contingency Calculation Template

Cost Element	Risk Summary	Likelihood (%)	Cost Impact	Contingency
Resources				
Mix	Risk that 50% of internal resources will neeed to be filled by System Integrator	50%	$ 75,000.00	$ 37,500.00
Scope/Effort	Due to current timing of estimate/lack of rule drafting, risk that scope/effort may increase by 25%	25%	$ 37,500.00	$ 9,375.00
Other (e.g. exchange rate)	Risk that AUD value will fall 10% against the USD increasing external vendor costs	75%	$ 8,640.00	$ 6,480.00
				$ -
Platform (e.g. Hardware, Licences etc)				$ -
Scope/Effort	Due to current timing of estimate/lack of rule drafting, risk that infrastructure requirements may increase by 25%	25%	$ 25,000.00	$ 6,250.00
Other (e.g. exchange rate)	Risk that AUD value will fall 10% against the USD increasing infrastructure costs	75%	$ 14,400.00	$ 10,800.00
TOTAL				**$ 70,405.00**
			Baseline Cost	$ 289,000.00
			Total Cost	$ 359,405.00
			Contingency Rate	24%

Calculation based on (SI costs per day less AEMO Internal Cost per Day) x Total Number of Internal Days in Estimate x % of

Calculation based on total Number of Days in Estimate x Estimated Effort Increase x Average Day Rate (in this case all AEMO Internal)

Calculation based on (Todays X-Rate x 10%) x Number of Hours Effort x USD Rate per Hour

Calculation based on 25% increase in baseline infrastructure estimate

Calculation based on (Todays X-Rate x 10%) x baseline infrstructure estimate

NOTES:

1) Risks/contingencies are mutulaly exclusive (e.g. scope risk isn't calculated after building in resource mix risk)

2) When clauclaing cost impact need to apply the correct Tier 1/2 day rates plus correct Financial Year Rates from Cost Estimation Sheet

An assessment of the risk-based contingency for each project has been provided to the ERA. Based on the most up to date information regarding project scope and resourcing, AEMO has revised the total contingency forecast amount from $17.9 million to $14.8 million (WEM and GSI). The revised total contingency amounts for each project (WEM component only) are presented in Table 2.

Table 2: Adjustments to forecast project contingency ($,000 nominal)

WEM capital project	Initial estimate ($,000)	% rate	Updated estimate ($,000)	% rate
Existing projects				
Power System Operation	55	13%	97	23%
E-terra upgrade	90	15%	N/A	N/A
System Management System Transition	506	23%	512	30%
Reduction of Prudential Exposure Phase 2	452	24%	606	32%
Sub-total existing projects	1,103		1,215	
New, small-scale projects				
POM AX database and metering	90	10%	75	8%
POM AX settlements replacement	465	41%	397	37%
Business continuity capability	115	30%	30	15%
STEM Fortran	108	30%	87	24%
Hardware and software lifecycle support	227	30%	154	22%

WEM capital project	Initial estimate ($,000)	% rate	Updated estimate ($,000)	% rate
Enhanced control room tools	70	30%	80	34%
Demand and renewable energy forecasting	21	30%	20	29%
Market operator interface	150	56%	40	12%
PASA process improvement	50	30%	43	26%
System Management application remediation	90	29%	90	29%
Spinning reserve cost allocation rule change	23	15%	15	13
Administrative improvements to outage process rule change	94	30%	152	25%
Identity and access management	234	29%	-	-
Sub-total new small-scale projects	1,737		1,183	
Large-scale, early stage projects				
Digital roadmap	2,842	30%	2,903	30%
WEM reform	11,987	31%	9,258	25%
Sub-total large-scale, early stage projects	14,890		12,162	
Total WEM forecast capital contingency expenditure	**17,730**		**14,560**	

The ERA suggests that an alternative to this risk-based assessment of project contingency is to use provisions for revenue and capital overspends in the WEM Rules. The ERA states:

> *WEM rules 2.22A.8 and 2.22A.9 enable AEMO to incur higher allowable revenue and forecast capital expenditure, up to 15 per cent and 10 per cent respectively, over a full allowable revenue period, before it needs to come back to the ERA for an in-period adjustment. This mechanism could be used as an alternative means of recognising uncertainty in AEMO's total capital program. The allowances could be a means of providing project contingency without requiring explicit identification of project risks.*[23]

AEMO does not consider this is a prudent alternative. AEMO agrees with the ERA's position that contingency costs of known projects should be justified based on project risk. Using clause 2.22A.8 or 2.22A.9 of the WEM Rules to accommodate project overspends on known projects, without the need to justify or at least identify project risks, would not promote transparency and may not result in the lowest practicably sustainable cost of delivering those projects. By including specific project contingencies in the expenditure forecast that can be tested and challenged by the regulator and market participants, AEMO is providing transparency of costs and can be called to account for delivering projects within a reasonable margin for error.

AEMO considers clauses 2.22A.8 and 2.22A.9 are designed to accommodate minor operating or capital cost requirements that arise during an allowable revenue period, which could not be forecast when the allowable revenue proposal was made. Historically, AEMO has reserved these clauses for this purpose and proposes to continue this approach for AR5.

[23] Ibid, page 17.

Development and implementation of business-as-usual rule changes

In its draft decision, the ERA highlights that stakeholders have expressed the view that AEMO should have a minimum provision in its allowable revenue and/or forecast capital expenditure for the development and implementation of business-as-usual rule changes.[24] The ERA therefore recommends:

> *For AEMO to estimate and propose an amount to be included in its AR5 funding for its market development (where appropriate) and implementation functions for business-as-usual rule changes under WEM rule 2.1A.2(IA) during the AR5 period. This estimate should be based on currently expected or known rule changes (outside the WEM reform program).*[25]

AEMO accepts this recommendation and has included forecast capital expenditure of $1.42 million to accommodate known business-as-usual rule changes that may need to be delivered during the AR5 period but are as yet undefined.

This forecast has been developed by reviewing existing information on known rule changes and making an informed judgement on what would be expected to proceed. The following sources have been used to inform the forecast:

- 'Open' rule changes on the Market Advisory Committee (MAC) website.[26]
- MAC Market Rules Issues List – last reviewed on 30 April 2019.[27]
- Pre-rule change proposals.

Following this, AEMO has applied a 'small-medium-large-major' approach to estimating costs using internal project sizing methodology (see Table 3) and recent Rule Change implementations as a guide for the upper cost bounds. While top-down, AEMO believes this is the most prudent way of estimating costs at this stage of refinement.

Table 3: AEMO's internal project size criteria

Small	Medium
• Little impact, complexity or risk. • Primarily involves one-two divisions. • Cost typically ~<$150,000.	• Some impact, complexity or risk. • May involve three or more divisions. • Cost typically ~<$500,000.
Large	**Major**
• May have impact on market(s) / participants, and or on AEMO's reputation. • Involves multiple stakeholder groups. • Material complexity (e.g. technology, resourcing, stakeholders etc.). • Contains significant risks (e.g. financial, technology, AEMO reputation, or impact to participants). • Cost typically ~>$500,000.	• Executive leadership-driven projects. • Significant direct impact on the market(s) / participants. • Significant impact on AEMO's reputation. • Significant complexity (e.g. across technology, resourcing, stakeholders etc.). • Contains significant or critical residual risks (e.g. financial, resourcing, technology, AEMO reputation, or impact to participants). • Cost typically ~>$2.5 million.

[24] Ibid, page 17.

[25] Ibid, page 17.

[26] https://www.erawa.com.au/rule-change-panel/market-rule-changes

[27] Available at: https://www.erawa.com.au/rule-change-panel/market-advisory-committee/market-advisory-committee-meetings

Table 4 provides a breakdown of known and expected rule changes, including cost estimates for consideration by the ERA. AEMO provides these estimates without prejudice and will undertake full assessments to support any rule change assessment as required.

Table 4: Known and expected rule change allowance

Group	Change/Topic	Size	Forecast ($,000)	Comments
Open rule changes	RC_2013_15 (Outage planning)	Small	70	Aligns with AEMO's submission to the RCP's Call for Further Submissions[28]. Not included in the initial AR5 submission as AEMO assumed it could carry out under the Western Power service agreement in the AR4 period.
	RC_2017_02 (30-min Gate Closure)	Small	100	Assumption that changes to implement 90-min Gate Closure will be initially pursued as per AEMO's submission to the initial proposal.[29] Further allowance provided for potential further changes to align Synergy's Gate Closure with IPPs.
Market Rules Issue List	Five 'Potential Rule Change Proposals' (Issues 31, 45, 46, 47 and 53) reviewed	Small	-	AEMO's initial view of these issues is that implementation is largely process/procedural and that there are no material implementation costs to be considered. AEMO recognises that broader Issues (e.g. behind-the meter and commissioning test processes) may be progressed to rule change proposals in the AR5 period but has not included these in this assessment.
Pre-rule change proposals	Relevant Level Methodology	Large	1,000	Implementation of changes following the ERA's review of the Relevant Level Methodology review. Discussed as a pre-rule change proposal at MAC on 30 April 2019.
	Adjusting Non-STEM Settlements using latest available data	Small	-	Discussed as a potential pre-rule change proposal at MAC on 2018[30]. AEMO assumes there will be no system/capital costs related to the changes.
	Calculation of Relevant Demand for Demand Side Programs	Medium	250	Discussed as a pre-rule change proposal at MAC on 5 February 2019. No rule-drafting provided to date.
TOTAL			1,420	

2.2.2 Existing projects initiated and partially funded in AR4

Power System Operations project

As identified in the draft decision, AEMO no longer plans to upgrade the e-terra energy management system from version 2.5 to 3.2. AEMO will instead implement version 3.2 directly. This means the $687,000 initially forecast for the upgrade is no longer required.

The ERA has accepted this adjustment and considers that *by implementing version 3.2 and taking advantage of internal resources and lessons learned from the upgrade in the NEM, AEMO has demonstrated that it has taken a prudent approach to minimising costs for this project*.[31]

[28] Available at: https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc_2013_15

[29] Available at: https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc_2017_02

[30] Meeting date 20 November 2018, available at: https://www.erawa.com.au/rule-change-panel/market-advisory-committee/market-advisory-committee-meetings

[31] ERA, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 26.

The ERA's draft decision is to approve costs for the implementation of the Power System Operations project (which will now be for the e-terra version 3.2), however, it excludes the $55,000 (13%) project contingency estimated for this work.

AEMO has reviewed all project contingency amounts and submits a 23% contingency ($100,000) is required for the Power Systems Operation project. The primary risk associated with this project is the potential complexity of implementation and the need for specialist resources to support resolution of issues. Though e-terra will have been installed in the NEM prior to its application in the WEM, the inherent differences between the WEM and NEM may give rise to integration issues. For example, the differing dispatch processes in the WEM compared to the NEM means e-terra will require some customisation for the WEM, which could make integrating the system more complex than expected. Additional resources may be required to implement the new energy management system as a result. This could include external specialist consultants or resources that come at a premium.

AEMO will take every opportunity to apply lessons learnt from the NEM implementation and has built the baseline cost estimate on this basis. However, for the reasons articulated above, AEMO believes contingency needs to be incorporated. Only costs actually incurred will be recovered from market participants.

System Management System Transition (SMST) project

The ERA's draft decision is to approve forecast expenditure of $1.703 million for the SMST project, however, it excludes the $506,000 contingency estimated for this work.

AEMO has reviewed all project contingency amounts and submits a 30% contingency ($512,000) is required for the SMST project. The primary risk associated with this project is the combination of a lack of documentation available to AEMO on Western Power systems, and limited resources with the required knowledge of how the underlying SM applications work. While AEMO has put together a reasonably confident scope and baseline forecast for the system transition, there is a high risk that integrating the many bespoke components of the SM systems may prove more complex than anticipated. Additional external resources may be required to help solve any integration problems that emerge.

The SMST is underway, and unanticipated costs and issues have already emerged during the systems transition phase (for example, AEMO had to source external expertise in webMethods to resolve some transition challenges). As the project enters the test and remediation phase, additional issues will likely emerge. The exact nature, volume and cost of these issues will not be clearly defined until the test and remediation phase has progressed further. It is therefore prudent to include a contingency amount for this project.

Reduction of Prudential Exposure (ROPE) Phase 2 project

The ERA's draft decision is to approve forecast expenditure of $1.872 million for the ROPE Phase 2 project, however, it excludes the $452,000 (24%) contingency initially estimated for this work. AEMO has reviewed all project contingency amounts and submits a revised 32% contingency ($606,000) is required for ROPE Phase 2.

The key project risks, which also have a high probability of occurring, are as follows:

- AEMO and the vendor are currently completing a deep dive elaboration into the settlement calculations and required interfaces to support daily prudential estimations. Due to the complexity of the settlement equations within the rules there is a high probability risk that developing, testing and certifying the new settlement calculation engine will require more effort than estimated[32]. Examples of the complexity that has been identified are the settlement of Intermittent Loads within the market and the different metering arrangements at each facility that need to be accommodated and the requirement to treat all settlement equations currently expressed as monthly in the rules as daily estimates. This indicates an increased risk to the project cost and schedule.

[32] AEMO has direct experience of these challenges following the implementation of the Government's revisions to the RCM flowing from the Electricity Market Review in 2016/17.

- The interfaces between the settlement calculation engine that will be developed in ROPE Phase 2 and the existing WEM Systems will be complex. This complexity is driven by the complex architecture and data flows in the existing WEM Systems. AEMO current view is that these interfaces represent an additional risk to the project scope, cost and schedule.
- During elaboration of the initial ROPE project scope, several key requirements for Phase 2 were attributed to Phase 1 of the project scope. These tasks will be required to be delivered in the AR5 period. These tasks are detailed in the system impact report and include:
    - Modification of RCM Settlements for integration with outstanding amount calculation.
    - Modification to Prudential Reporting to provide screens for credit support and prudential breakdown.
    - Modification to SPARTA interfaces for GST and interest.

AEMO will continue to refine the scope further and will endeavour to deliver the project within the baseline forecast. However, there are some elements of additional design scope that are essentially certain following further elaboration and AEMO considers it prudent to include a contingency amount of 32% for this project.

2.2.3 New small-scale projects

POMAX Oracle database and metering upgrade

The ERA's draft decision is to approve forecast expenditure of $946,000 for the POMAX Oracle database and metering upgrade, however, it excludes the $90,000 (10%) contingency estimated for this work.

AEMO has reviewed all project contingency amounts and submits an 8% contingency $75,000 is required for the POMAX Oracle database and metering upgrade.

The POMAX project is well advanced and the risks associated with project delivery are clearly defined. As a result, the contingency amount for this project is relatively low. Further analysis of the project risks, combined with more up-to-date information on the project status, has enabled AEMO to reduce the contingency estimate from the initial 10% assessment. The projected project spend is almost entirely labour, split between internal and external resources. The 8% contingency assessment is based on the following project risks:

- It is unlikely but possible that some of the predicted internal roles may need to be filled by external resources, or that the internal resources assigned need to be backfilled by external resources.
- The predicted external resource cost is based on a fixed-price vendor quote. While that mitigates the contingency requirement to an extent, the final scope (due to other in-flight projects) cannot be confirmed until the contract is signed.
- Based on previous experience, the internal resource costs may vary if there are significant issues during the database upgrade or subsequent testing.
- The external service provider is based overseas and provides quotes in USD, therefore there is an exchange-rate risk.

POMAX settlements replacement

The ERA's draft decision is to approve forecast expenditure of $1.132 million for the POMAX settlements replacement, however, it excludes the $465,000 contingency originally requested for this work.

Prior to the release of the draft determination, AEMO submitted a revised budget request of $1.127 million. The contingency amount has been reviewed and an updated request for 37% contingency ($400,000) is required for the POMAX settlements replacement.

AEMO acknowledges that the contingency for this is significant. The broad contingency required is due to the interdependency between this and two other projects (ROPE Phase 2 and POMAX Oracle database and metering upgrade), which means there are considerably more variables and delivery risks than in a less complex standalone project.

Most of the budget for the POMAX settlements replacement is based on external resources. The cost estimates currently provided from external vendors are based on a rough order of magnitude (ROM), with a more detailed quote to be provided closer to the project implementation. This detailed quote will provide a tighter scope and contingency requirement, and will take into consideration the costs, resource requirements and outcomes of the ROPE Phase 2 and POMAX Oracle upgrade projects. Until this more fully-informed quote is available, the external vendor's ROM estimate has a +/- 50% degree of confidence attached to it. AEMO therefore considers it prudent to include a contingency amount to accommodate the upper bound of the vendor's estimate.

As well as the contingency for external resources, the other project risks are as follows:

- It is unlikely but possible that some of the predicted internal roles may need to be filled by external resources, or that the internal resources assigned need to be backfilled by external resources.
- Based on previous experience, the internal resource costs may vary if there are significant issues during the testing.
- The costs associated with the hardware may also vary slightly as the scope is refined further.

Once the more detailed cost estimate has been determined, AEMO will revised its baseline cost assessment accordingly and would expect the required contingency to be less. AEMO will apply its well-established and proven capital project governance procedures and will endeavour to deliver the POMAX settlements replacement for the lowest practicably sustainable cost. Until such time, the 37% contingency has been arrived at on a reasonable basis and represents the best forecast available in the circumstances.

Only capital expenditure actually incurred will be recovered via allowable revenue, with the majority of costs recovered during the AR6 period (via recovery of depreciation). Where market fees during AR5 are impacted, these will be adjusted accordingly via the annual update mechanism. Market fees for the AR6 period will be set during the AR6 allowable revenue and forecast capital expenditure review process during 2022.

Business continuity capability project

In January 2020, AEMO's System Management service agreement with Western Power comes to an end. From this point onwards, Western Power's real-time operations backup facility will no longer be available to AEMO. AEMO must therefore make its own backup arrangements.

During its review of AEMO's initial submission, the ERA has sought more information on AEMO's proposed backup solutions, and acknowledges that new backup arrangements are required. However, as a final decision on the backup facility had not been made by AEMO at the time of making its draft decision, the ERA opted not to approve and publish a forecast capital amount in its draft decision, so as not to potentially compromise ongoing commercial negotiations.

AEMO has since identified its preferred backup facility and has submitted updated costs and scope to the ERA. The revised capital cost estimate is $230,000, which includes a contingency amount of $30,000 (15%).

The 15% contingency is based on the risk that the assumption of internal resources required to deliver these works (as opposed to external resources) is too low. The contingency is also required to accommodate any potential variance in hardware/technical requirement for the backup facility. While AEMO has a reasonably solid understanding of the systems and technical requirements for a secure backup facility, detailed technical discussion with the property owners and fitters has not yet commenced. This means there is a risk the technical solution may be more complex than anticipated. There is also an exchange rate risk, as many of the system components will be sourced from overseas.

STEM Fortran replacement project

The ERA's draft decision is to not approve forecast expenditure of $469,000 for the STEM Fortran replacement. The ERA raises two matters:

1. AEMO did not provide information on why the project needs to be undertaken in the AR5 period, and why it was not undertaken during the AR4 period.

2. The annual market audits have not identified any risks linked to the Fortran language and have not made any recommendations to replace the STEM Fortran code.

Replacing STEM Fortran was proposed in both the AR3 and AR4 periods and featured in the forecast capital expenditure at the time. The replacement projects were justified based on market incidents due to limitations of the code base and the availability of support for the product which was written in the late 1990s. The delivery approach in each period was as follows:

- In the AR3 proposal, the IMO proposed a Fortran, C and Perl replacement project within the IT Roadmap. The project was proposed to be delivered as part of the then IT Roadmap or as part of a system rebuild in 2016-17[33]. However, due to the subsequent transition into AEMO, the IT Roadmap projects were postponed.
- In the AR4 proposal, AEMO included STEM Fortran replacement costs within the broader WEM energy and ancillary services project in the wholesale work stream of the WA Electricity Market Review (EMR). Specifically, AEMO proposed to deliver systems for a day-ahead market that is integrated with other market and settlement systems[34]. Again, the subsequent suspension of the EMR meant the STEM replacement was again postponed.

AEMO has been consistent regarding the requirement to deliver the STEM Fortran replacement over recent allowable revenue periods. In each case the ERA has acknowledged the risk associated with running an outdated system and approved the capital expenditure forecast.[35] The AR3 and AR4 project deferrals have been the result of circumstances outside of AEMO's control. However, the risk associated with Fortran remains.

In its draft decision, the ERA recognises that the main driver for this project was to mitigate the risk associated with running outdated systems for real-time market operations and the availability of resources to provide support. This risk raises the following concerns:

- AEMO may be unable to implement any proposed rule change to the STEM processes in an efficient or cost-effective manner without replacing the system.
- If an underlying bug or non-compliance with the Market Rules is identified AEMO may not be able to correct the non-compliance in an efficient or cost-effective manner without replacing the system.
- There may be a heightened risk of STEM delays or STEM suspensions.
- The STEM application interfaces with several other AEMO systems. Therefore, as AEMO changes and modifies its other systems as part of other projects (e.g. POMAX Settlements replacement, RoPE phase 2) or WEM reform, the interfaces with the STEM application must be maintained. This requires development and testing, which can be onerous due to the antiquated nature of the systems.

The risks associated with the product were discussed by both the market auditor and the ERA in 2011 in response to a non-compliance that occurred on 23 March 2011. This incident was caused by a limit on the number of Market Participants in the STEM Fortran code[36]. This was the main driver for the inclusion of the project in the AR3 period. The ERA noted[37] four occasions where the IMO experienced issues with the STEM

[33] Refer to ERA Submission Proposal for Allowable Revenue and Forecast Capital Expenditure 1 July 2013 to 30 June 2016, November 2012, page 16. Available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations/allowable-revenue-period-from-1-july-2013-to-30-june-2016

[34] Refer to 2016–19 ALLOWABLE REVENUE SUBMISSION TO THE ECONOMIC REGULATION AUTHORITY, September 2016 page 36. Available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations/allowable-revenue-period-from-1-july-2016-to-30-june-2019

[35] Note that the forecast capital costs associated with the proposed STEM replacement during AR3 and AR4 were not incurred and have not been recovered via allowable revenue.

[36] Refer to Independent Market Operator Compliance of the IMO's internal processes and procedures with the Market Rules and the IMO's compliance with the Market Rules and Market Procedures, September 2011 p25 https://www.aemo.com.au/-/media/Files/Electricity/WEM/Compliance/2007-2016/audit_1_2011.pdf

[37] Refer to 2011 Annual Wholesale Electricity Market Report for the Minister for Energy, p51 https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-wholesale-electricity-market-effectiveness-reports/wholesale-electricity-market-effectiveness-report-201011

due to IT limitations. The ERA noted it is a core function of the IMO to ensure its systems are functioning effectively and emphasised their concern with the IT issues.

AEMO has broadened the scope of market audits in recent years to highlight areas of risk and propose appropriate recommendations in addition to identifying non-compliances with the WEM Rules. In its preliminary findings as part of the 2019 market audit, the market auditor has indicated it intends to make a general finding regarding the wide range of technologies used to implement AEMO systems. AEMO expects the finding will mention the STEM Fortran codebase and the broader difficulties in recruiting and maintaining an internal IT team with all the required skills.

AEMO believes replacing the STEM auction code base in the AR5 period remains the most prudent approach to address the above risks. The Public Utilities Office has indicated the core design of the STEM will remain unchanged through the WEM reform program. AEMO is therefore confident the STEM code base will not need to be replaced as an outcome of WEM reform and will ensure the project is delivered in line with AEMOs technical requirements under the digital strategy.

The capital cost of resources and platform for this project remains the same at $361,000. However, the contingency figure has been reviewed and reduced from $100,000 (30%) to $90,000 (24%). It is unlikely but possible that some of the predicted internal roles may need to be filled by external resources, or that the internal resources assigned need to be backfilled by external resources. Also, based on previous experience, the internal resource costs may vary if there are significant issues during the testing.

Hardware and software lifecycle support project

The ERA's draft decision is to approve forecast expenditure of $696,000 for hardware and software lifecycle support for GSI, however, it excludes the $208,000 (30%) contingency estimated for this work.

AEMO has reviewed all project contingency amounts and submits a contingency of $154,000 (22%) is required. Hardware and operating system requirements are directly impacted by the software asset lifecycle management processes of a large number of systems. As software and asset management practices change, so too does the hardware requirement. Given the large number of systems currently being managed and the expected changes and improvements to systems over the course of the AR5 period, hardware requirements are likely to vary from forecast over the three years of the period. However, these detailed requirements cannot be quantified accurately at this time and therefore the bulk of the contingency is associated with this risk.

A significant amount of hardware is sourced from overseas vendors, which means there is also the risk that exchange rate variations may impact the eventual costs of the hardware purchased. Therefore, it is prudent to include a reasonable contingency in the capital forecast. As with all capital projects, AEMO will endeavour to deliver the project within the baseline cost estimates, and only costs actually incurred will be recovered via allowable revenue in the future.

Enhanced control room tools

AEMO is implementing a suite of new control room tools to provide improved situational awareness of real time issues. These tools will be prototyped to test if the information captured and the methodology for doing so meets AEMO's requirements, before developing more robust tools in-house.

In its draft decision, the ERA has not approved forecast capital expenditure to develop these tools, as it requires further information on the tools that would be developed and why they are needed over and above changes that will form part of WEM reform and the digital roadmap. The ERA recommends AEMO should identify *any situational awareness tools need that may not be enabled through the WEM reform and the digital roadmap projects, considers options to address those needs and then defines a capital project or projects to deliver the required tools for the control room.*[38]

[38] ERA, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 31.

To further inform the ERA's final decision, AEMO submits the following information on the proposed tools and the timing of their development.

The proposed tools are:

- Inertia tool (2019-20)

  As the amount of inertia on the system reduces due to increasing inverter connected generators as well as reducing load, the consequence of contingencies increases as the rate of change of frequency (ROCOF) increases. As inertia decreases, the minimum frequency following a generator contingency will reduce. If inadequate spinning reserve is available for that particular contingency, the frequency may reduce to a value below 48.75 Hz, at which point under frequency load shedding (UFLS) will operate. If the ROCOF is too extreme, UFLS may not operate as expected. AEMO requires a tool that provides controllers with a view of the amount of inertia provided by synchronous generators on the network, so that AEMO can monitor and manage ROCOF more accurately. AEMO currently has a prototype inertia tool, which it is developing in-house. This tool, once validated, will be built as an application that is stable, fit for purpose and integrated with other operational tools and systems.

- Volt/Var management tool (2020-21)

  With the increasing penetration of photovoltaic systems into the South West Interconnected System (SWIS), volt/var management at low loads is becoming increasing challenging. While e-terra will provide a module for system studies that will identify contingency violations (including voltage violations), it will not provide guidance on rectifying these violations. It is necessary to have a clear view of the available reactive power capability (importing and exporting) at a facility and in an area to respond to various contingencies. A visualisation tool will provide this real time situational awareness capability to the control room, potentially highlighting where actions need to be taken to ensure the system remains secure.

- System strength tool (2021-22)

  As the nature of the power system changes, the ability of the protection systems to perform as designed will be challenged. A tool to identify, in real time, areas where system strength is weak will allow the controllers to make changes to the power system to ensure system strength is managed to such a level that protection and other systems will operate as designed.

Each of these tools will be developed in-house, which AEMO considers is the lowest cost option and most practicable way of implementing effective tools for the SWIS. AEMO has investigated off-the-shelf options, and while situational tools are available, these generally require heavy customisation. AEMO's experience is that the level of customisation and the potential for ongoing vendor support can make these tools expensive to maintain, with the costs disproportionate to the value these tools provide to the controllers. Where relatively simple in-house tools can be developed and maintained, this is typically a more efficient approach.

AEMO has considered the option of maintaining the existing systems and not developing new tools at this time. However, this would not address the requirement to capture better information on what is an increasingly complex power system. The scope of the digital roadmap and the WEM reform programs does not include improved situational awareness tools.

AEMO also requires a better system to enable controllers to log real time operational events that occur during each shift. AEMO proposes to implement the MIAMI electronic logging tool, which is currently used by AEMO in the NEM. Again, the ERA has not approved this expenditure as AEMO *has not provided information on alternative options such as implementing procedural changes to encourage controllers to correctly use the existing electronic logbook.*[39]

Currently WEM controllers use a Microsoft Excel spreadsheet for shift logging of all events, phone calls and equipment faults. This is then saved after each shift as an individual file into the AEMO document management system. The shortcomings of this process are that records are not searchable and there is no clear auditable history of events short of manually reviewing each individual day of events. Implementing

[39] Ibid, page 31.

procedural changes to ensure controllers use the logbook correctly is part of a potential solution, however it would not address the main issue, which is that the shift records are not searchable as long as they remain in Excel format. Implementing MIAMI will enable records to be searched and interrogated more easily, and represents an efficient and relatively inexpensive solution given AEMO already uses this tool in the NEM.

The total capital costs of the enhanced control room tools development and MIAMI implementation is estimated at $314,000. This includes contingency of $80,000 (34%).

Given the requirement to integrate data from other sources, there is a risk developing the tools may be more complex than initially estimated, requiring external expertise. While having the prototype inertia tool in place has allowed AEMO to reduce the original contingency requirement to some extent, there remains a need to accommodate the costs of any specialist resources that might be required to ensure the full suite of new tools are stable and fully integrated. There is also a risk iinternal developer/testing roles may not be available and may need to be filled by external resources.

Demand and renewable energy forecasting project

The ERA's draft decision is to approve forecast expenditure of $69,000 for the demand and renewable energy forecasting project, however, it excludes the $21,000 (30%) contingency estimated for this work.

AEMO has reviewed all project contingency amounts and submits a 29% contingency $20,000 is required for the demand and renewable energy forecasting project. Though AEMO's plan is to use an existing forecasting tool and internal resources to deliver this solution, a small contingency is required in the event external resources are required. As with other NEM-based tools and systems that are being applied in the WEM, there is also a risk integration of the new forecasting tools could prove more complex than anticipated. It is therefore prudent to include contingency in the capital forecast for this project.

Market operator interface

AEMO's market operator interface (MOI) is a legacy system written using Java applet technology. Java applets are no longer supported by major browsers, and AEMO is forced to use workarounds to mitigate the resulting security concerns. In its initial submission, AEMO estimated $420,000 (including 56% contingency[40]) is required to re-write the MOI front-end application and modify the WEMS to increase security and reliability. As highlighted by the ERA in its draft decision, *AEMO has considered alternative options before proposing this project*.[41]

The ERA's draft decision is not to approve forecast capital expenditure for this project. This is because the ERA considers:

> *...AEMO has not fully justified why this project is necessary in the AR5 period. The WEM reform project is expected to replace this MOI system in three to five years. There is insufficient explanation of the frequency and consequence of risks that may arise from maintaining existing arrangements for the next few years that justifies the project expenditure as being least practicable sustainable cost*.[42]

AEMO therefore provides the following information in support of the MOI project.

The MOI modification is necessary in the AR5 period to mitigate operational risk to AEMO. At present, the security vulnerabilities and lack of browser support for applets has been worked around using Citrix. However, Citrix is scheduled for retirement within AEMO.

Migrating a similar workaround on to a new solution would entrench poor practice, and would require funding to implement. Furthermore, the fact remains that an inability to remove applets from the WEMS codebase prevents AEMO from updating the entire WEM systems to a supported version of Java.

[40] Note the 56% contingency was an error, the contingency amount should have been 30%.

[41] ERA, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 32.

[42] Ibid, page 32.

If the MOI is not modified, AEMO would be operating all the WEM market systems with software that is unsupported by the platform vendor (Oracle). This includes external facing components of the WEMS such as the market participant interface.

Should AEMO encounter a serious Java defect or other system issue during the AR5 period, AEMO would need to update all of the WEMS code (including rewriting the relevant MOI functionality) to the latest version of Java before it can obtain support from Oracle. During this period there would be a significant risk of market systems being unavailable, and possible STEM suspension. The cost to the market of STEM suspension would likely be substantial.

The aim of the MOI project is to mitigate operational risk be ensuring the WEM systems are supportable for the duration of the AR5 period. Given the forthcoming WEM reforms, it would not be efficient to build a new long-term asset, therefore AEMO's plan to rewrite only the MOI user interface using contemporary front-end technologies is the most practicable and least cost solution.

With regard to the frequency of issues associated with the current state of the MOI user interface, on at least two documented occasions in 2018, the MOI user interface has resulted in erroneous actions being taken by experienced users when administering events. This has led to balancing merit order generation being missed.

The 56% contingency stated in the initial submission was an error. The $420,000 project cost included 30% contingency. The ERA was advised of this in response to a query on the initial submission.

The overall revised cost is now $363,000 including a 12% contingency. This contingency has been reduced because there is now more certainty around the costs associated with various resourcing strategies. However, there remains some risk additional scope and effort will be necessary during implementation, which may require additional resources.

PASA process improvement

AEMO has initiated a project to improve the content and timely reporting of short-term and medium-term Projected Assessment of System Adequacy (PASA) forecasting. This initiative is a response to audit findings and feedback from market participants.

In its draft decision, the ERA has not approved the PASA costs on the basis it considers AEMO has not demonstrated that alternative approaches to the proposed solution have been considered. The ERA highlights that the 2018 audit of AEMO's compliance with the WEM Rules[43] and market procedures categorises the PASA non-compliance as low risk. The ERA also observes that *these issues have also existed for some time with no evidence of any material consequences for market participants*.[44]

PASA is an important factor when outage planning and is used by market participants and AEMO to schedule outages. Clause 3.18.11 of the WEM Rules requires AEMO to assess outage plans based on strict criteria. These criteria are referred to by AEMO as the Reserve Margin. Steps 4.1.1 and 4.1.2 of the proposed Power System Operation Procedure for Short Term and Medium Term PASA clarify the use of PASA as follows:

- The PASA Reserve Margin is the capacity remaining in service, as detailed in step 4.2.1, used to evaluate Outage Plans [Clause 3.18.11] and to approve Planned Outages [Clause 3.19.6]
- AEMO must assess the PASA Reserve Margin for each PASA Reference Point in the Short Term PASA Planning Horizon.

To increase the efficiency of market outcomes, the Reserve Margin should be as accurate as is reasonably practicable. Therefore, all factors that contribute to the Reserve Margin, such as demand side programs and non-scheduled generation should be included. However, the current PASA tool precludes AEMO from incorporating these factors.

[43] Robinson Bowmaker Paul, 2018, *Australian Energy Market Operator Independent Assurance Report on AEMO's Compliance with the WEM Rules and Market Procedures*.

[44] ERA, May 2018, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 33.

As a result, the assumptions currently applied in the PASA tool are outdated, leading to inaccurate Reserve Margin assessments. This inaccuracy introduces risk to power system security and reduces market efficiencies by impacting opportunities for market participants to request outages. It is this risk to the market – and not necessarily the risk of AEMO's non-compliance – that is the primary driver for the PASA improvements.

While the 2018 audit identifies the non-compliance as low risk, a number of these risks have materialised into breach incidents. These breach incidents have not as yet caused material detriment to market participants. However, continued inaccuracy of the Reserve Margin gives rise to the risk of material error that may compromise system security. This risk is only set to grow as the market becomes more complex and the prevalence of non-scheduled generation and demand side programs increases. Though the ERA is correct in its assertion that there have been no material consequences to date, it does not follow that material consequences will not arise if the current PASA process is retained.

AEMO proposes to improve the PASA process via developing a relatively simple and inexpensive tool to replace the current tool, which leverages a suite of Microsoft applications and operational database. Alternative options have been investigated, including off-the-shelf solutions or adapting the PASA tool that is used in the NEM.

Outage planning in the WEM uses a unique set of assumptions and processes. These assumptions and processes differ significantly from those in the NEM, therefore the effort required to modify the NEM PASA tool would be similar to the proposed WEM PASA tool. As a result, there is no material advantage of modifying the NEM tool rather than developing a new WEM solution at this time based on the current WEM arrangements. Similarly, there are no off-the-shelf solutions available that would require a lesser amount of modification than building a new tool in-house.

In its draft decision, the ERA suggests that *some of the issues identified by the audit could also be addressed by improving internal AEMO processes with adequate oversight to ensure the quality and completeness of forecast prior to publishing short-term and medium-term PASA forecasts*.[45]

AEMO has considered this possibility, however, improving oversight of the existing process alone would only address one aspect of the current PASA limitations. Though quality of the report may improve, the time it takes to develop PASA for publication would not. One of the primary PASA issues that can affect participants is that AEMO cannot quickly publish updates to the short-term PASA when material changes occur – this is due to the manual and onerous PASA process. Replacing the current Microsoft-based system with a more intuitive custom-built tool will increase the turnaround time of PASA reports and, allow the frequency of publication to increase, which will mean greater accuracy in outage planning and more opportunities for Market Participants to plan ahead.

The total capital costs of the PASA solution is estimated at $209,000. This includes contingency of $43,000 (26%).

The revised contingency amount (compared with the 30% proposed in the initial submission) is a result of scoping work on the PASA tool prototype now being complete. However, contingency is still required for this project as the prototype is yet to be tested with market participants. During 2019-20, AEMO will share the prototype with participants and seek input on the content and their expectations of AEMO's PASA reporting capability. This consultation process will inform the scope for the final PASA tool, which will be developed during 2020-21.

As a result, there is a risk the scope of the final tool will increase or will require additional effort in order to deliver what market participants want. There is a risk internal resources may not be available and may need to be supplemented with external resources. There is also a risk that integrating new data sources such as transmission information, may prove more challenging than originally anticipated.

[45] Ibid, page 33.

System Management application remediation project

The SMST project will see the System Management (SM) systems currently housed within Western Power transferred onto AEMO's IT infrastructure. AEMO will then be in a position to address the many shortcomings of the existing systems, which include security issues, poor performance and capacity limitations. In its initial submission, AEMO estimates $406,000 (including contingency) is required to remediate the SM systems. The ERA draft decision is not to approve this forecast as:

> *There is a lack of detail on what changes or enhancements AEMO wants to undertake on these short-lived systems, which is why the first task has been identified as producing a remediation roadmap. There is insufficient detail to identify these capital cost estimates as meeting the funding requirements in the WEM rules…*[46]

AEMO acknowledges this draft position and provides additional information on the remediation requirements. One of the deliverables of the SMST project (which is currently in progress) is a remediation roadmap for the SM systems post migration.

At the time of writing of the initial AR5 submission, the SMST project was in the early phases of execution. While there were known remediations, items documented from the planning phase, which were used to inform this estimate, they were not considered to be the definitive scope of this project as there was strong likelihood of further issues being discovered during the execution phase.

The SMST project has now progressed to the point that there is clarity on what the key remediation items are. Though there may be further issues identified during the remainder of the project, which may affect the priority/order of the tasks undertaken, the current plan is to progress remediation activities as follows:

- 2019-20 – Historically, errors/non-compliances in the systems management market operations space have arisen due to the use of manual processes for market management activities. One such process is the zeroing out of ex-ante and ex-post RCOQ. AEMO is required to manually check and correct ex-ante and ex-post outage values if a facility is commissioning or an intermittent generator is on outage. The SM team has a very small window of time (nine minutes) to perform the checks and correction. If the task is missed or errors are made, SM is in breach of market rules. Automation of processes would enable AEMO to avoid non-compliances and increase operational efficiency. The estimated cost of this work is $52,000 including contingency.
- 2019-20/2020-21 – Remediation of security concerns whereby internal services are not authenticated nor protected by Transport Layer Security (TLS), or that a number of applications (e.g. non-scheduled generation forecasts or network operations interface reports) running macros require an exemption to allow users to run them from known locations. Other applications require implementation of two-factor authentication to comply with AEMO's cyber security requirements. A security exemption for one year was sought and granted to remediate these issues. The estimated cost of this work is $109,000 including contingency.
- 2020-21 – The system operations control centre user interface (SOCCUI) is used to plan the Synergy portfolio and dispatch generation facilities in accordance with the WEM Rules where manual dispatching is required. The SOCCUI allows users to add constraints, override the real-time dispatch engine process, and change the demand forecast used to generate dispatch instructions. It is also used to formulate dispatch plans over the pre-dispatch horizon, view historical dispatch instruction data, and view the demand forecast over a 6-hour and 48-hour time horizon. The SOCCUI application is limited and changes are difficult to implement. It requires updates every time a new facility comes online and as a result, the SOCCUI has deteriorated to the point where the application fails regularly. Given the number of facilities expected to come online in the next three years, the SOCCUI requires significant remediation. This work will be delivered in the first half of the financial year. The estimated cost of this work is $179,000 including contingency.

[46] Ibid, page 33.

- 2021-22 – The remaining funds ($62,000) are a provision for any other critical remediation work identified during the remainder of the transition.

The underperformance of the current SM systems has led to a number of compliance breaches resulting from not using the latest balancing merit order. In its draft decision the ERA observes that it has not identified any material consequences from AEMO's non-compliance and notes there has been a reduction in the frequency of these types of events occurring.[47]

While these breaches have not yet materially impacted market participants, AEMO is obligated under clauses 7.6.1 C(a) and (b) of the WEM Rules to use the latest balancing merit order to dispatch the power systems. Dispatching out of merit order undermines the current market design and leads to outcomes that are less efficient than they otherwise would be. Failing to address preventable system issues that result in out-of-merit dispatch does not reflect the actions of a prudent operator.

AEMO therefore submits that the SM system remediation activities outlined above are necessary, prudent, and reflect the lowest practicably sustainable costs of providing services. A $90,000 (29%) contingency for this project is required, due to AEMO's lack of familiarity with the migrated systems. As discussed, the SMST is ongoing, and it is not until the systems have been transferred on to AEMO's IT infrastructure that a tighter scope of requirements and the remediation roadmap can be developed. This means there is a risk the actual remediation requirement may be more complex than currently envisaged, or that external resources may be required to undertake the work.

AEMO will review the remediation project forecast when the SMST is complete and will endeavour to deliver the project within the baseline forecast amount, however, it is prudent to include a contingency at this time to accommodate potential scope complexity.

Spinning reserve cost allocation rule change

The ERA's draft decision is to approve forecast expenditure of $114,000 for the spinning reserve cost allocation rule change, which reflected a revised lower estimate provided following the submission (less contingency).[48]

AEMO has reviewed all project contingency amounts and submits an 13% contingency ($14,650) is required for spinning reserve cost allocation rule change project. This small contingency is required to accommodate the risk that the solution provider (Brady) has underestimated the requirements and complexity of the solution, or that edge cases occur. There is also a risk that the internal resources proposed to test the solution would have to be replaced with a labour hire recruit.

Administrative improvements to outrage process rule change

The ERA's draft decision is not to approve the estimated $408,000 capital expenditure forecast for implementing a rule change to improve the outage process. This is because the scope of the original rule change (from 2014) is being reconsidered and AEMO advised it would submit updated costings to the Rule Change Panel in May 2019.

AEMO has been engaging with the Rule Change Panel Secretariat since submission of this forecast and has been exploring different scope items and approaches to delivery. This is principally driven by the delay in the Rule Change commencement requiring system implementation to occur after the completion of the SMST project. This delay has provided greater flexibility and options for delivery of this rule change. Based on these discussions, AEMO now has the revised costings and submits that $759,000 is required to implement this rule change based on the current understanding of scope. These costings will be provided to the Rule Change Panel Secretariat shortly with final and formal estimates to be provided in response to the Draft Rule Change Report.

[47] Ibid, page 33.

[48] AEMO provided updated costs to the ERA following its submission with a baseline of $114,500 and 15% contingency of $17,100.

This estimate includes project contingency of $150,000 (25%), which reflects that the scope of the Rule Change and the cost benefit assessment (and therefore the requirements and technical approach) are yet to be finalised.

Identity and access management project

The ERA's draft decision is to approve forecast expenditure of $112,000 for the Identity and Access Management project. This varies from the amount originally requested, however, it is in line with a revised forecast provided by AEMO to the ERA prior to the release of the draft decision. The revised forecast of $168,000 (WEM & GSI) reflects removal of some costs that were incorrectly allocated to WA and that the project has commenced early, with most of the costs being incurred during the AR4 period. The WEM portion of this project for AR5 is $112,000, with no contingency required as the project is almost complete

2.2.4 Large scale, early stage projects

Digital roadmap

As highlighted in the ERA's draft decision, AEMO uses multiple standalone systems in the WEM, some of which are end-of-life, or are inflexible and cannot be easily scaled or adapted. Many of the systems used in the WEM differ from those used in the NEM and will continue to due to the inherent differences between the two markets. However, there are several AEMO-wide business systems that are shared by AEMO in WA, such as cyber security systems, databases and corporate applications.

AEMO's plan is to have a common centralised platform upon which to build all future IT infrastructure. Moving from standalone arrangements to a common infrastructure platform across the entire business means all parts of AEMO can share the same tools and processes and in-house knowledge for developing systems. This provides opportunity for efficiencies in provision of business systems for AEMO WA, and will ultimately allow AEMO to develop and maintain WEM and GSI systems more efficiently.

AEMO will deliver the digital roadmap over the next five years, with most of the cost allocated to the NEM. The WEM allocation is $13.0 million and $0.8 million to GSI.

AEMO remains of the view that a three-year forecast capital expenditure determination for the digital roadmap would result in the lowest practicably sustainable cost of delivering this work. AEMO therefore submits the $13.8 million (WEM and GSI) forecast should be approved by the ERA in its final decision.

The ERA's draft decision is not to approve any forecast capital expenditure for the digital roadmap. This is because at the time of preparing the AR5 proposal, the specific benefits to the WEM and GSI of the various systems that will be delivered by the digital roadmap had not been identified. The ERA also considers that *the costs and benefits of the digital roadmap for Western Australia need to be more clearly defined before funding for the digital roadmap can be demonstrated to meet the funding requirements in the WEM rules*.[49]

AEMO accepts that the ERA (and market participants) requires further information, and provides a breakdown of some of the more clearly defined programs in the following sections. A complete picture of the five-year digital roadmap and the various systems, costs and benefits this program will deliver is not available at this time. In recognition of this, the ERA has recommended AEMO:

> *Estimates the resources required to undertake more detailed scoping and planning for incorporating WEM and GSI requirements into the Australia-wide digital roadmap. This should enable:*
>
> – *Identification of the costs and benefits of the digital roadmap for the WEM and GSI, compared to developing a Western Australian specific digital roadmap, as was proposed and delivered by the former Independent Market Operator.*

[49] ERA, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 36.

– *Clarification of the timing, and therefore the profiling of the costs and benefits of transitioning the standalone WEM and GSI systems onto the common infrastructure platform, 'cyber security', 'data' and 'solutions' aspects of the digital roadmap.*[50]

AEMO will aim to provide as much information as possible on the benefits and scope of the WEM and GSI requirements in time to help inform the ERA's final decision on 14 June. Given the tight time constraints, it is likely that any analysis provided to the ERA ahead of its final decision will be preliminary only. A further cost-benefit analysis will be used to inform actual expenditure and project delivery during the period, which will help promote prudent investment and ensure only efficient costs are recovered via allowable revenue.

AEMO has sought external advice on the benefits of the digital roadmap to WA and the potential economies of scale resulting from AEMO WA being part of a broader technology program. This external advice indicates utilising shared services functions can lead to significant quality improvements and cost reductions of 15% to 30%.

By aligning to AEMO's digital roadmap, WA would have access to this new computing platform to host its current and future systems, and could lower its capital and operating costs by 15% to 35%. Using AR4 and AR5 costs as a guide and assuming no change in AEMO functions or data requirements, a 15% operating cost saving would have been $450,000 per year during AR4 and $500,000 per year during AR5. A 15% capital saving from the implementation of the digital roadmap would have resulted in $1.4 million per year in AR4 and a $3.9 million per year saving for AR5.

AEMO strongly recommends that forecast capital expenditure for the full three years ($13.0 million WEM and $0.8 million GSI) be approved in the ERA's final decision. This will enable the digital roadmap program to proceed as planned and ensure AEMO WA benefits from the economies of scale and scope of being part of a large-scale IT uplift. AEMO's internal governance processes will promote efficient investment and market fees will be adjusted to ensure market participants only pay for costs actually incurred. AEMO submits this would result in the digital roadmap being delivered for the lowest practicably sustainable cost.

Since the initial submission in March, further work has been done to refine the scope and quantify some of the benefits of the digital roadmap program for WA. Several elements of the digital roadmap are AEMO-wide business systems, which are not designed to deliver specific benefits to the WEM, GSI or NEM. AEMO submits that costs to implement these systems can be demonstrated to satisfy WEM Rule requirements and be approved in the final decision.

The digital roadmap is an AEMO-wide initiative, designed to standardise and improve critical IT systems across the entire organisation. While some systems within the roadmap are designed to deliver improvements to market operations and system management (both in the NEM and WEM), others are business applications such as cyber security, web services and data management. The primary purpose of these AEMO-wide business systems is to allow exchange and interaction between AEMO staff and applications, enabling AEMO to operate as an organisation. They are not specifically designed to operate the market(s).

AEMO has identified these business systems, specifically those proposed to be delivered during the first year of the AR5 period. As these systems are scheduled to be implemented within the next twelve months, more detailed information is available on the scope, cost and likely benefits. AEMO therefore requests that as a minimum, the ERA approves $4.5 million (WEM component only) of forecast capital expenditure for elements of the digital roadmap to be delivered in 2019-20. A capital expenditure forecast for the remainder of the AR5 period can then be submitted in-period.

As discussed in the ERA's draft decision[51], the digital roadmap program has four work streams: solutions, data, compute and cyber security. Each of these work streams are split into 'critical pillars' of work, which in turn contain numerous projects over the five-year program. Projects within each pillar feature upgrades to AEMO-

[50] Ibid, page 37.

[51] Ibid, page 36.

wide business systems, WEM and GSI systems, and NEM systems. Table 5 shows the expenditure forecast on AEMO-wide business systems for the first year of the AR5 period.

Table 5: WEM forecast capital expenditure on business systems 2019-20, ($,000 nominal)

Work stream	Pillar	Project	Forecast cost
Solution	Digital delivery	AEMO web digital enhancement	165
	Corporate systems	Design	254
	Enterprise capabilities	Enterprise architecture uplift	191
Data	Consumption	Enterprise data consumption tool foundation build	99
	Governance	Enterprise data governance framework	158
Compute	Platform infrastructure	Hybrid cloud detailed design and build	1,349
	Service management	Service management	528
Cyber security	NIST protect	Identity and access management	812
	NIST protect	Security awareness, training and culture	76
	NIST protect	Key controls	264
	NIST protect	Secure in design, dev and ops	120
	NIST detect & respond	Assurance, testing and exercise	254
	NIST detect & respond	Threat detection and response	276
Total			4,546

The amounts in Table 5 are the forecast costs to deliver each project in its entirety during 2019-20. Additional costs for these projects are not forecast for 2020-21 or 2021-22. In the event the ERA opts not to approve the full three-year forecast for the digital roadmap, a detailed breakdown of forecast costs for projects in 2020-21 and 2021-22 will be provided as part of an in-period adjustment.

Further information on the digital roadmap business systems to be delivered in 2019-20 is provided in the following sections.

Solution – Digital delivery – AEMO web digital enhancement

The solutions work stream focuses on delivering fit for purpose and cost-effective software applications that will be standardised across the businesses, as well as improved DevOps and software enhancement capabilities. One of the first projects to be delivered is an enhancement to AEMO's corporate website.

Scope/Background:

The current AEMO website is limited in its usability and needs a considerable rebuild. The website suffers from poor navigation, complex content and low digital functionality, which means users often struggle to access the information they require, being forced to contact AEMO directly instead. The current website architecture is also fragmented, with limited integration across disparate portals, logins and access to data sources. Essentially, different users are provided access to different portals in different ways. This means the user experience across the organisation is inconsistent.

AEMO proposes to uplift the user experience across channels by simplifying and standardising web interactions and improving digital functionality, including mobile capability. The project will also build flexibility into the digital architecture, which will allow AEMO to develop new visualisations, data services and features quickly and efficiently.

All market portals across all AEMO jurisdictions will be accessible via the homepage, and the searchability and format of market data will be standardised. The concept is that users will be able to locate more of the data they require themselves, enabling them to access critical information quickly without having to wait for responses from AEMO personnel.

Options and benefits

This is an AEMO-wide initiative and AEMO WA is required to adopt the same website and platform as the rest of the organisation. This is consistent with current arrangements.

AEMO has considered the option of recreating a separate website for AEMO WA and maintaining it independently. While this will allow AEMO to more clearly allocate costs between NEM and WEM participants, AEMO considers creating an independent website is not prudent. This would essentially reverse the decision made in 2016 to adopt the AEMO web platform and result in additional costs to extract the AEMO WA site from the broader AEMO web services. Further, while it may be possible to build a standalone website for WA at a similar upfront cost to the digital roadmap forecast, the effort to manage and maintain the site would be duplicated within AEMO.

Therefore, AEMO WA continuing to use AEMO-wide corporate site is the recommended option. The new website will result in a better user experience, and the new user access interface/portal created will likely be the entry point for WA systems post the WEM reforms.

With regards to specific options considered for the delivery of the new website, three options were considered:

1. Modify existing website using current software (Sitecore).
2. Upgrade current software to latest version (Sitecore 9.1) and modify content and structure to suit current requirements.
3. Invest in new software/product and migrate relevant content on to new platform.

The current version of Sitecore is already out of mainstream support and into extended support. Extended support for the current version is due to end within the AR5 period. As a result, keeping the current version of Sitecore would not be prudent.

Migrating to an alternative software would introduce cost, and unnecessary complexity and risk. The current Sitecore software is fit for purpose and AEMO has not identified additional benefits other software offers that would justify the additional cost and risk. Therefore, AEMO considers the prudent approach is to upgrade Sitecore to the latest version and has adopted options two as the recommended approach.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $165,000.

Solution – Corporate systems – Design

One of the most important projects within the solutions work stream is the design and review of the current state of AEMO's corporate systems capabilities. This project will inform the subsequent corporate applications to be utilised by AEMO, including AEMO WA.

Scope/Background

AEMO uses a large number of corporate applications across its jurisdiction. Many of the applications may be playing duplicate roles, meaning there is an opportunity to rationalise applications and achieve cost savings.

The purpose of the corporate systems design project is to review all current applications, costs, usage and functionality and develop the roadmap for consolidating and/or rationalising the following systems:

- Success Factors (employee directory).
- Talent management.
- Finance/HR system.
- Employee app.
- Risk and value management tools.
- Artificial intelligence enabled governance, risk and compliance tools.
- Contracts management tools.
- Enterprise content.

Options and benefits

AEMO WA currently uses these same corporate applications as the rest of the organisation and will be required to use them going forward. Having the same vendor management systems, finance systems, and content management systems across AEMO will ensure internal processes are streamlined, reduce duplication of effort, and enable AEMO WA to achieve efficiencies (where practicable) from being part of a larger organisation with economies of scale. Therefore, it is important that WA is considered as part of this design and review project.

An alternative option would be to conduct a separate WA review, to determine whether a disparate suite of WA-only corporate applications would be more efficient for AEMO. However, it is unlikely that having separate corporate systems in WA would ultimately result in the lowest practicably sustainable cost option, as it would mean duplication of licences, service management and vendor support.

AEMO proposes that WA requirements will be considered as part of the corporate systems design review, and the findings will inform the applications that are ultimately adopted by WA. Therefore, AEMO submits that the costs for this review should be allocated to WA proportionally.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $254,000.

Solution – Enterprise capabilities – Enterprise architecture uplift

Scope/Background

AEMO has not needed to invest heavily into its enterprise architecture function since 2013. As a result, there is no central repository for ensuring the correct architectural artefacts are created, and no description of how the various enterprise artefacts hang together. This leads to inefficiencies when developing new or making significant changes to existing enterprise systems, as engineers need to spend time mapping the system architecture. Detailed knowledge of the enterprise architecture is limited to a small group of people. This will create a bottleneck in project delivery and the current model is not sustainable.

The enterprise architecture uplift project will create a detailed, central repository of AEMO's enterprise-wide architecture, which can be utilised by all software and hardware engineers. The repository will map all artefacts and clearly show the interrelationship between systems, allowing for a standardised approach to IT development. Creating and maintaining this architecture information will reduce development time for new system solutions, enabling more efficient project delivery and change management.

Options and benefits

This an AEMO-wide initiative, which will focus initially on business systems. However, WA-specific systems that support the WEM and GSI will ultimately benefit from this project, as having the enterprise architecture clearly defined will help inform any future system enhancements. Expected benefits to all AEMO as a result of this project include:

- Reduction in project costs as there will be no need to develop analysis of current state and subsequent target state for every project.
- Reduction in technical debt as project solutions align with enterprise goals.
- Ability to flex to meet increased project demand.
- Ability to identify new approaches and technologies that can deliver business outcomes faster and at a lower cost.
- Ability for projects to be delivered more quickly as standards, guidelines, and patterns will be available.
- Reduced costs by identifying opportunities to rationalise business applications.

An alternative option for WA would be to create a separate enterprise architecture for the AEMO WA systems, with a view to developing bespoke AEMO WA systems. However, this would result in duplication of effort. It is also not practical to 'do nothing' and constrain system knowledge to a small pool of expertise. It should be noted that the risk is potentially greater in WA, as the architecture knowledge of WEM and GSI systems is limited to even fewer people within WA, and is generally unknown across the rest of the organisation. It is therefore prudent for WA to participate in the project and for WA systems to remain in scope of the enterprise architecture uplift.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $191,000.

Data – Consumption – Enterprise data consumption tool foundation build

The data work stream focuses on delivering insights via data curation, manipulation and interrogation from various sources to provide services to customers. One of the first projects to be delivered is the introduction of an enterprise data consumption tool.

Scope/Background

AEMO's various systems contain a huge amount of data. However, there is a lack of consistency in the way data is accessed and stored. This fragmentation of data is largely due to insufficient investment in IT system consolidation historically, and AEMO inheriting several disparate legacy systems. As a result, enterprise-wide data is often duplicated and challenging to search and analyse.

AEMO proposes to create an enterprise data consumption tool for use in data analytics, forecasting and reporting. The tool will enhance AEMO's document sharing and collaboration capability, so it can share data securely with key partners for research and collaborative initiatives. Having a secure and efficient data sharing capability has become even more critical as the energy industry transforms. Importantly, this tool will also enable AEMO to identify and eliminate data duplication and inaccuracy.

Options and benefits

This is a foundation project that is being applied across the entire organisation. The tool is not designed to deliver specific enhancements to corporate, WEM and NEM systems, rather it will simply enable more efficient data handling across the organisation.

Given AEMO WA will utilise and stands to benefit from improved data handling, it is proposed that the capital costs of this work be allocated to WA proportionally. This will ensure WA data requirements are captured in the initial review and avoid rework later.

AEMO will have a modern, supported, standardised reporting and analytics capability and tool (and associated training), which will make it easier to consume, forecast and analyse data and construct reports. AEMO will be in a position to move away from legacy, unsupported / difficult to manage tools over time as new / ongoing reports are re-created in the new tool. AEMO will be able to reduce the amount of manual (or heavily automated via internally written macros) spreadsheet reporting currently taking place.

In terms of a WA-specific solution, one alternative could be for the tool to be developed by AEMO across its other jurisdictions and then WA pays separately for WA-specific processes and is charged on a consumption basis for its use. However, if WA requirements are not funded and explicitly captured in development of the tool, it would potentially result in an inferior product for WA. It is not prudent for AEMO WA to maintain existing sub-standard data handling processes.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $99,000.

Data – Governance – Enterprise data governance framework

Scope/Background

As explained above, data in AEMO is currently fragmented and its data management practices, though secure, are less than optimal. AEMO proposes to establish a governance framework and roadmap to align leadership around a shared data vision, operating model and investment in data. This framework will provide capability to centrally govern data investments, identify and resolve overlaps, and share learnings.

Options and benefits

The governance framework will apply right across the organisation. There is no formal data governance framework in place in WA or AEMO's other jurisdictions, so there is an opportunity to establish a consistent governance approach at relatively low cost.

This project meets AEMO's requirement to provide a prudent and efficient service, as a well-defined and managed data governance model will avoid over-engineering of technology services. For example, not every service needs to be highly confidential, highly secure, or highly available, so the costs associated with applying these more rigorous controls can be minimised. Conversely, the data governance framework will ensure critical services and sensitive data are treated appropriately.

A data governance framework will provide:

- Capability to identify, raise and prioritise resolution of issues relating to data.
- Accountability to resolve / manage adverse effects of poor data quality.
- Improved access and interrogation of data, reducing the time it takes for people to find the data they need.

As per the enterprise data governance tool, an alternative to WA contributing to the capital cost of developing the framework is for the framework to be developed in isolation and then WA to be charged for its use. However, this may result in rework and would require development of a usage-based charge back mechanism, which would be difficult to quantify and impractical to apply.

AEMO considers it would not be prudent for AEMO WA to operate under a disparate data governance framework.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $158,000.

Compute – Platform infrastructure – Hybrid cloud detailed design and build

The compute work stream focuses on delivering a secure and scalable computing platform, with centralised delivery, service and support. One of the most critical programs of work within the compute stream is development of a hybrid cloud-based infrastructure platform.

Scope/Background

AEMO's existing technology infrastructure platform has evolved over the past 20 years and has been drawn together from multiple, formerly disparate, organisations. As a result, the current infrastructure platform is outdated, inflexible, and not ideally suited to support newer technologies. The current platform has a networking layer that drives a high cost of entry and operation for a limited cohort of potential systems. It is also unable to support a flexible and full mobile work environment.

The detailed design and build project will form the basis of a new hybrid cloud-based platform on which all future AEMO applications can be based.

Options and benefits

AEMO expects the new platform will enable new systems to be developed and hosted more efficiently. This includes AEMO-wide business systems and ultimately any new systems designed to support the NEM and WEM. AEMO expects the new platform to support any systems created or enhanced as part of WEM reform.

While the precise benefits to the WEM reform program cannot be quantified at this time, AEMO expects building the hybrid platform and ultimately hosting WEM systems on it will result in lower marginal costs of investment. For example, if AEMO invests in building the platform now, the hardware costs of the WEM systems (and any other systems what use the platform) will be marginal at around 8-12% of what they would be if a new platform had to be built for each of those systems. Further, by sharing one platform (rather than managing disparate platforms for the AEMO and AEMO WA), ongoing service charges should be lower, and enhancements/modifications can be delivered more quickly.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $1.35 million.

Compute – Service management

The compute work stream is divided in to four critical pillars, one of which is service management. The service management projects to be delivered during 2019-20 relate are designed to improve:

- Event performance and capacity.
- Service transition.
- Asset configuration and IT financial management.

Scope/Background

Currently, the delivery of some IT services across AEMO are tailored for each business function and market jurisdiction. As a result, the IT procurement and implementation practices can vary slightly by function, as well as the level of service management and monitoring.

AEMO proposes to develop and implement a series of standardised and fit-for-purpose IT service management processes. This will include consistent interfaces, common practices, transparent IT cost models, a structured chargeback mechanism and an IT finance management framework. Improved service management will also include end-to-end monitoring of applications, platforms and networks (inclusive of on premise and cloud).

The scope of the service management project includes:

- Event performance and capacity:

    - Requirements, design and roadmap.
    - Application performance management.
    - Consolidating tools.
    - Establishing platform managers.
    - Application performance management.
    - Event correlation and management.
    - Complete service mapping.
    - Create, optimise metrics and dashboards.
    - Implementation of capacity management process - flow, reports metrics.
- Service transition:
    - Map and implement the release framework.
    - Automate touchpoints with DevOps.
    - Implement transition gates and governance.
- Asset, configuration and IT financial management:
    - Uplift service catalogue.
    - Software license management.
    - Embed finance cost models and linkage to service catalogue.
    - Fill gaps in asset management, linkage to contract management.

Options and benefits

As with the enterprise governance data framework, the new service management processes will be applied right across the organisation. Enhanced service management is not designed to deliver specific benefits to any single corporate, WEM or NEM system, rather it will uplift the IT capability of AEMO more broadly, leading to long-term and sustainable efficiencies. AEMO WA will be required to use the same service management processes as the rest of the organisation, therefore the costs of developing the new framework should be allocated to WA proportionally.

An alternative to WA contributing to the capital cost of developing the enhanced service management approach is for the service management processes to be developed in isolation and for WA to then be charged for usage as an operating cost. However, AEMO considers this approach would be no more efficient than AEMO WA participating in the program now and recovering costs via depreciation in the future. It would also require an amount to be approved in the AR5 allowable revenue determination to cover the service management costs.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $528,000.

Cyber security introduction

AEMO is driving an overall cyber security uplift across the Australian energy sector, playing a lead role in the Australian Energy Sector Cyber Security Framework (AESCSF).[52] The AESCSF is an initiative whereby market participants across the NEM and the WEM can assess the criticality of their cyber security risk and their resilience to cyber attack. Creation of the AESCSF, as well as the increased focus on cyber security, is driven by the recommendations of *the Independent Review into the Future Security of the National Electricity Market* –

[52] See: http://energylive.aemo.com.au/News/Protecting-industry-from-cyber-incidents

Blueprint for the Future – June 2017 (the Finkel Review Report), which highlights cyber security as a critical risk for power systems.

As highlighted in the *2018 Summary Report into the cyber security preparedness of the National and WA Wholesale Electricity Markets*[53], AEMO has completed a stocktake of current cyber security regulation procedures (as per recommendation 2.10.2 in the Finkel Review Report) and concludes that current provisions are inadequate to address cyber security risk to the NEM, and by extension, the WEM.

Under the AESCSF, each participant is assigned a criticality rating out of 100, which dictates the maturity level each organisation should aim for in its cyber security capabilities. As the electricity market operator and system manager, AEMO is rated 95-100 on the criticality scale. This is because a cyber attack on AEMO's systems can have flow on effects for participants downstream in the electricity supply chain.

Given AEMO's high criticality, it is prudent for AEMO to target a high degree of rigor and sophistication in its cyber security capabilities. To measure its cyber security capabilities, AEMO uses a framework developed by the U.S. National Institute of Standards and Technology (NIST). The NIST cyber security framework is a forerunner to the AESCSF and is accepted as industry standard practice worldwide.

NIST provides standards, guidelines and practices to manage cyber security risk, and is typically adopted by organisations responsible for critical infrastructure and technology (such as power systems and other utilities). The NIST framework has five cyber security core functions, which are defined below:

- Identify – Develop an organizational understanding to manage cyber security risk to systems, people, assets, data, and capabilities.

  The activities in the Identify function are foundational for effective use of the framework. Understanding the business context, the resources that support critical functions, and the related cyber security risks enables an organisation to focus and prioritise its efforts, consistent with its risk management strategy and business needs. Examples of outcome categories within this function include: asset management, business environment, governance, risk assessment, and risk management strategy.

- Protect – Develop and implement appropriate safeguards to ensure delivery of critical services.

  The Protect function supports the ability to limit or contain the impact of a potential cyber security event. Examples of outcome categories within this function include: identity management and access control; awareness and training, data security, information protection processes and procedures, maintenance, and protective technology.

- Detect – Develop and implement appropriate activities to identify the occurrence of a cyber security event.

  The Detect function enables timely discovery of cyber security events. Examples of outcome categories within this function include: anomalies and events, security continuous monitoring, and detection processes.

- Respond - Develop and implement appropriate activities to take action regarding a detected cyber security incident.

  The Respond function supports the ability to contain the impact of a potential cyber security incident. Examples of outcome categories within this function include: response planning, communications, analysis; mitigation and improvements.

- Recover - Develop and implement appropriate activities to maintain plans for resilience and to restore any capabilities or services that were impaired due to a cybersecurity incident.

  The Recover function supports timely recovery to normal operations to reduce the impact from a cyber security incident. Examples of outcome categories within this function include: recovery planning, improvements and communications.

[53] https://www.aemo.com.au/-/media/Files/Cyber-Security/2018/AEMO-2018-AESCSF-Report.pdf

The NIST framework provides a tier rating, which reflects the degree of rigor and sophistication in cyber security risk management practices at an organisation. Tiers range from 1 (Partial) to 4 (Adaptive).

Given AEMO's 95-100 criticality rating under the AESCSF, AEMO is aiming for a NIST Tier 4 rating for each function. The cyber security work stream of the digital roadmap is designed to enable AEMO to achieve Tier 4 status.

If, due to insufficient funding, AEMO WA is unable to integrate its systems into AEMO's broader, more robust cyber security arrangements, AEMO WA and its market systems would need to be extracted from the existing cyber security arrangements. This would be an additional (and avoidable) cost on top of the costs to develop standalone WA security arrangements.

Maintaining current cyber security arrangements would offer less resilience should cyber security issues emerge. AEMO WA's ability to detect, prevent and recover from cyber security attack is fundamental to its ability to deliver the services defined under clause 2.22A of the WEM Rules. Doing nothing exposes AEMO in WA and places the systems and markets it operates at unacceptable risk of breach and potential failure. If the balancing market of STEM were to be suspended for a significant period because of cyber attack, the cost to the market could run into millions of dollars, as well as potentially compromising the integrity of the power system.

Details of the propose cyber security projects for 2019-20 are provided below.

Cyber security – NIST protect – Identity and access management

The aim of the NIST protect program of work is to develop and implement appropriate safeguards to ensure delivery of critical services. A critical project to facilitate that requirement is the identity and access management project. Tranche 1 of this work has already commenced and will be mostly complete during the AR4 period – the estimated costs of finishing Tranche 1 has been addressed separately in the AR5 submission. Tranche 2 is scheduled for implementation in 2019-20.

Scope/Background

Building on the work already completed in Tranche 1, Tranche 2 will focus on:

- Market application identification management – this secures AEMO's market applications to ensure effective identity and access lifecycle management controls are in place.
- Business to business – this delivers new access and identity management services to support AEMO's collaborative data sharing initiatives with partner organisations such as the Bureau of Meteorology and the CSIRO.
- Privileged access management controls – this secures access the AEMO's technology system accounts with elevated administrative privileges (e.g. domain administrator).
- Business to consumer – this establishes the first layer of consumer identity management services to support emerging services delivered to consumer level end-users (e.g. consumer data platform).

Tranche 2 of the identity and access management project will build on the foundational design and implementation activities already initiated and will extend from the corporate/enterprise system in to the WEM and GSI domains. While some of this work will need to be revisited when existing WEM systems are replaced, the potential impact of rework is more than offset by mitigating the potential risk – especially now AEMO has full accountability for system management technology services.

Options and benefits

This project is the next stage of AEMO's identity and access management project and will increase the resilience of all AEMO systems from cyber security attack. It is therefore prudent to continue to include AEMO WA in this project and provide an amount of forecast capital expenditure sufficient to cover the forward-looking costs of cyber security.

Given the impracticality of AEMO WA not proceeding with the AEMO-wide identity and access management project and reverting to standalone arrangements, and alternative option has not been considered for this project. Doing nothing is deemed too high a risk to AEMOs critical services.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $812,000.

Cyber security – NIST protect – Security awareness, training and culture

Scope/Background

One of the biggest cyber security risks in any organisation is the potential for third parties to target employees and attempt to exploit their access to IT systems and services. This practice is known as 'spear-phishing'. The security, awareness, training and culture project seeks to reduce AEMO's vulnerability to spear-phishing.

This project will focus on improving awareness for all AEMO employees in three key areas:

- Home – a campaign that focuses on cyber security as a twenty first century life skill that starts with personal awareness at home.
- Work – a campaign that focuses on everyone's responsibility at work and how to play your part through increased knowledge.
- Industry – a campaign that enhances the awareness of AEMO's industry leading position to drive cyber awareness through sector-wide exercises.

Options and benefits

This project is the maturation of AEMO's existing cyber security processes and methodology and will increase the resilience of all AEMO systems from cyber security attack. It is an enterprise capability and is service agnostic (neither corporate, WEM, or NEM specific).

Given the requirement for AEMO's employees in WA to share systems and interact with AEMO's employees in other states, it is impractical to exclude WA-based employees from the cyber security awareness program. It is therefore prudent to continue to include AEMO WA in this project and provide an amount of forecast capital expenditure sufficient to cover the forward-looking costs of cyber security in WA.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $76,000.

Cyber security – NIST protect – Key controls

Scope/Background

It is imperative AEMO continues to adapt and evolve its cyber security capabilities to ensure it can protect its critical systems and functions. The key controls project will improve AEMO's cyber security control mechanisms, focusing on the following areas:

- Distributed denial of service protection – improved resilience against denial of service attacks.
- Governance, risk and compliance service management – improved compliance and risk traceability across AEMO's technology services.
- Email security and protection – to ensure the integrity of AEMO's email services.
- Cloud based web proxy services – transformation of AEMO's web proxy services from on-premise to cloud based technologies, which will improve scalability, performance and resilience.

- Software defined security – a range of controls to support the large-scale adoption of cloud-based application services.

Options and benefits

This project is the maturation of AEMO's existing cyber security capabilities and will increase the resilience of all AEMO systems from cyber security attack. It is an enterprise capability and is service agnostic (neither corporate, WEM, or NEM specific).

Given AEMO WA will continue to share several business applications with the rest of the organisation, it is prudent for AEMO WA requirements to be factored into this project and have costs allocated to it accordingly. It would be impractical for AEMO WA to have disparate cyber security arrangements, as this would result in duplication of costs and may result in AEMO WA employees being unable to access key systems. An alternative standalone solution for WA has therefore not been costed.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $264,000.

Cyber security – NIST protect – Secure in design, dev and ops

Scope/Background

The secure in design, dev and ops project will enhance AEMO's security architecture framework, which underpins AEMO's ability to secure its digital and technology systems and services. The project will deliver progressive releases of AEMO's security architecture framework to allow agile systems development, cloud services and emerging technologies to be adopted.

Options and benefits

This project is the maturation of AEMO's existing cyber security capabilities and will increase the resilience of all AEMO systems from cyber security attack. It is an enterprise capability and is service agnostic (neither corporate, WEM, or NEM specific).

Given AEMO WA will continue to share several business applications with the rest of the organisation, it is prudent for AEMO WA requirements to be factored into this project and have costs allocated to it accordingly. It would be impractical for AEMO WA to have a disparate security architecture framework, as this would result in duplication of costs and may result in AEMO WA employees being unable to access key systems. An alternative standalone solution for WA has therefore not been costed.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $120,000.

Cyber security – NIST detect and respond – Assurance, testing and exercise

The aim of the NIST detect and respond program of work is to develop and implement appropriate safeguards to ensure delivery of critical services, and to develop and implement appropriate activities to identify the occurrence of a cyber security event.

Scope/Background

The current approach to cyber security governance for the provisioning of new services is well established but the governance and auditing capabilities for those services once deployed lacks maturity. The purpose of this project is to enhance those capabilities and will focus on the following areas:

- Assurance testing tools embedded into operations – this enables the cyber security operations teams to continuously assess and validate the compliance posture of production services.

- Prioritised security compliance assessment and remediation – a multi-year program to progressively remediate known compliance gaps across the legacy services using a risk-based approach.

Options and benefits

This project is the maturation of AEMO's existing cyber security capabilities and will increase the resilience of all AEMO systems from cyber security attack. It is an enterprise capability and is service agnostic (neither corporate, WEM, or NEM specific).

As per the other cyber security projects, given AEMO WA will continue to share several business applications with the rest of the organisation, it is prudent for AEMO WA requirements to be factored into this project and have costs allocated to it accordingly. An alternative standalone solution for WA has therefore not been costed.

Cost

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $254,000.

Cyber security – NIST detect and respond – Threat detection and response

Scope/Background

The ability to detect and respond to threats to AEMO's digital and technology systems and services is critical to ensure the availability, integrity and security of these systems. This project will ensure AEMO's threat detection and response capability continues to evolve and adapt to new, more sophisticated cyber security challenges. The project scope includes:

- Malware protection controls – transformation of the end-point security controls across all AEMO's technology systems.
- Security information and event management instrumentation for visibility and analytics – a new security incident and event management platform to improve security in on-premise and in-cloud technology services.

Options and benefits

This project is the maturation of AEMO's existing cyber security capabilities and will increase the resilience of all AEMO systems from cyber security attack. It is an enterprise capability and is service agnostic (neither corporate, WEM, or NEM specific).

As per the other cyber security projects, given AEMO WA will continue to share several business applications with the rest of the organisation, it is prudent for AEMO WA requirements to be factored into this project and have costs allocated to it accordingly. An alternative standalone solution for WA has therefore not been costed.

This project is expected to be completed in 2019-20 and the WEM component of forecast capital expenditure is $276,000.

WEM reform and a staged approval process

The ERA has approved an amount of forecast capital expenditure equivalent to the funding required to fund activities during the first year of WEM reform, plus funding for AEMO's WEM reform 'core' team[54] for the full three years (excluding contingency). AEMO understands the ERA's reluctance to approve implementation costs until more detailed scope and costing information becomes available.

If the ERA maintains this position in its final decision, the approved forecast capital expenditure would enable AEMO to deliver tranche 1 of the WEM reform program but it would have insufficient resources available to deliver tranche 2.

AEMO maintains its view that approving funding for the full three years would be a more prudent and efficient course of action, and can be approved under the requirements of clause 2.22A.11(b).

There are four key reasons for this:

1. AEMO faces efficiency losses due to the risks of not attracting appropriately skilled internal recruits and/or the imposition of risk premiums by external vendors (potential increase of $2.2 million).
2. There are direct costs incurred by AEMO (and the ERA) in the development of and engagement on supplementary capital expenditure submissions (~$0.17 million additional AEMO costs for a supplementary submission).
3. The risk of delays (e.g. while teams await funding certainty) leads to direct cost increases because fixed cost resources are utilised for a greater amount of time (potential increases of $0.75-$1.25 million).
4. Program delivery, and therefore benefits realisation, is at risk of delay as the focus of the WEM reform team is diverted to supplementary submissions and/or teams are required to wait for further funding certainty.

Further explanation of these reasons, including estimates of potential dollar impacts (where possible) is provided below.

Efficiency losses – recruitment and contracting

A three-year determination will enable AEMO to secure more favourable rates when acquiring the resources required to implement the WEM reforms. Though the ERA has approved funding for the core team, additional resources will be required to design and implement new systems and processes. If AEMO only has one year of budget approved, then it can only offer these resources one-year contracts – whether this be for internal fixed term contractors; labour hire contractors; or consultants (e.g. System Integrator).

However, if there is funding certainty for three years, AEMO can offer three-year contracts and is more likely to be able to recruit these resources at a lower rate. The majority of these implementation resources will need to be sourced during the first year of the AR5 period, therefore AEMO cannot wait until the outcome of an in-period adjustment proposal before it offers terms to potential contract staff. As a prudent operator, AEMO would only be able to offer short-term contracts, to avoid the risk of incurring penalties for early termination. These short-term contracts would typically attract a premium.

For the WEM reform program, AEMO is currently forecasting recruitment of up to eight employees to internal fixed term contracts into roles including Test Lead, Developer, Tester and Operational SMEs (e.g. engineers to develop constraints management tools). The following table provides a summary of cost impacts if 50% of these roles are not able to be recruited and are therefore supplied by labour hire contractors or consultants:

[54] AEMO has reviewed this calculation and believes it reflects the Program Management and Market Design resources already employed by AEMO but does not cover essential resources required to develop operational tools (e.g. constraints management) or plan and manage the IT system implementation (e.g. Test Lead). This forward estimate does not also include contingency; or borrowing costs. AEMO has provided ERA with an alternative estimate of these costs, which are c. $20 million.

Table 6: Cost impact if 50% WEM reform roles are supplied by labour hire or consultants

Approach	2019-20	2020-21	2021-22	TOTAL
All internal (Base)	$1,028	$1,488	$1,545	$4,062
50% labour hire	$1,194	$1,726	$1,782	$4,702
50% IT consultant	$1,602	$2,315	$2,387	$6,305

The following table provides a summary of cost impacts if labour hire contractors and IT consultants include a risk premium into their day rates to reflect uncertainty and opportunity cost.

Table 7: Cost impact if WEM reform labour includes a risk premium

Approach	2019-20	2020-21	2021-22	TOTAL
Base cost	$1,514	$6,041	$6,140	$13,695
5% risk premium	$1,589	$6,343	$6,447	$14,379
10% risk premium	$1,748	$6,978	$7,091	$15,817

Direct costs for submission and review

The second reason why a three-year forecast is approvable under the WEM rules is that it eliminates the need to incur costs associated with making an in-period submission. These costs can be significant for both AEMO and the ERA[55], but most importantly, these costs are avoidable.

The ERA points out *that approving a three-year allowable revenue and forecast capital expenditure does not provide certainty that AEMO will not request additional funding during AR5*[56]. This is not incorrect, however, making a three-year determination would significantly reduce the likelihood that AEMO will make the request. By only approving one year of the forecast, the ERA is providing absolute certainty that AEMO *will* make a request for additional funding and will incur the costs associated with making that request. Subject to clause 2.22A.11(b) of the WEM Rules, a final decision that requires AEMO to incur additional avoidable costs does not represent the lowest practicably sustainable cost of providing services.

Reflecting on the resources and effort required for the supplementary AR4 submission in July 2018[57], AEMO estimates the direct costs incurred for a further submission to be ~$28,600 per month or ~$0.17 million based on a three-month preparation and three-month review/approval process.

Direct costs related to delays in submission and approval process

The forecast quarterly labour 'burn rate' in the WEM reform program ranges from ~$1.5 million to ~$2.5 million per quarter (ramping up from Q1 2019-20 to Q2 2020-21). If the program delivery is delayed as a result of having to submit and/or wait for further funding approval, then a level of resource cost will be incurred over and above what would otherwise have been incurred if the re-submission was not required. While AEMO would plan to minimise this risk through the timing of its submission and management of variable resources, even a 50% increase in cost for a three-month delay (e.g. where AEMO was able to reallocate some resources to other initiatives) would result in ~$0.75 million to $1.25 million in avoidable and additional costs to the WEM reform program.

[55] There are also avoidable costs for stakeholders who wish to review and engage in the review process.

[56] ERA, May 2018, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 20.

[57] Assumption that any further submission would be CAPEX only and focussed on WEM reform with potential for a number of additional smaller projects, which is more aligned with the AR4 Supplementary submission than the 'full' AR5 submission.

Delayed benefits

The WEM reform program is being implemented on the basis it will deliver significant benefits to the SWIS and WA energy consumers. These benefits are aligned with the intent to better meet the WEM objectives and will therefore contribute to the provision of secure, reliable energy and the lowest practicably sustainable cost. While quantification of these benefits is yet to be completed (this is a key activity for the Government as part of the design stage of the program), any delays to implementation as a result of having to resubmit a capital forecast will delay benefit realisation and potentially increase risk of maintaining secure and reliable supply.

Contingency

As with all other capital projects, the capital expenditure forecast for WEM reform includes an amount to cover project contingencies. AEMO submits a project contingency of $9.3 million (25%) is necessary and justifiable for WEM reform.

The contingency is principally required due to the current stage of market and regulatory design (i.e. high-level) and the lack of detailed business and system requirements. This scope uncertainty has been acknowledged by the ERA and is the rationale of its draft decision to recommend a staged submission and approval process. As per the arguments above, AEMO contends it is more efficient to provide a full three-year allowance and that adequate contingency is both necessary and an accepted project planning approach.

Beyond the underlying scope risk, the WEM reform program also faces risks regarding the ability to secure the preferred resource mix and accurately forecast requirements for platform costs, certification and expenses. These risks were identified and assessed as part of the initial submission with a per-cost line and per-year breakdown of contingency requirements provided. These contingency calculations have been reviewed and updated following the ERA's draft decision, the review has resulted in a lower requirement than originally calculated (25% vs 30%), noting that there is no management reserve included in the contingency estimate.

Conclusion

While AEMO understands the ERA's and market participants' concerns regarding approving implementation costs at this early stage, AEMO believes a three-year determination is approvable under the WEM Rules, and that this is supported by the increasing momentum and certainty in the WEM program.[58]

The allowable revenue and forecast capital expenditure review process is designed conceptually to approve a three-year forecast, arrived at on a reasonable basis, that will determine market fees for the period. Annual fee adjustment mechanisms exist to ensure market participants do not pay for services they do not receive, and to correct for forecast error. In-period forecast capital expenditure adjustments add avoidable costs to the market and should be reserved for exceptional circumstances where a reasonable forecast is not achievable.

The top-down estimate of implementation costs for WEM reform provided to the ERA has been arrived at on a reasonable basis and represents the best possible forecast in the circumstances. Most importantly, the amount the ERA would approve is a forecast only. Actual costs will likely vary from the forecast, and the way the regulatory framework is designed means market participants will only pay for costs actually incurred.

AEMO submits that approving the full three-year forecast will result in the lowest practicably sustainable cost of delivering the program and will ensure AEMO has sufficient revenue to cover the forward-looking costs of providing services. AEMO therefore recommends the ERA revisits its draft decision not to approve a three-year forecast.

[58] AEMO notes the establishment of the Government's Energy Transformation Strategy Taskforce and the Energy Transformation Implementation Unit on 20 May 2019, which demonstrate a focus and commitment to the Reforms - https://www.mediastatements.wa.gov.au/Pages/McGowan/2019/05/McGowan-Government-creates-Energy-Transformation-Taskforce.aspx

2.3 GSI allowable revenue and forecast capital expenditure

2.3.1 GSI revenue

In its draft decision, the ERA considers AEMO's proposed GSI allowable revenue is reasonable and is approved in principle. AEMO will adjust the final GSI allowable revenue prior to the ERA's final decision, pending the ERA's revised forecast capital expenditure position.

One required adjustment to revenue (and forecast capital expenditure) relates to the IASB's new accounting standard for leasing, which takes effect from 1 July 2019. The impact of this new standard is that $247,000 of GSI accommodation costs will be treated as capital expenditure. The overall cost impact is neutral.

2.3.2 GSI forecast capital expenditure

As with the WEM, the most significant variation between AEMO's GSI proposal and the ERA's draft decision is the forecast capital expenditure. The ERA has adjusted project contingencies on the hardware and software lifecycle support project and the identity and access management project. Both these projects have GSI components. The exclusion of digital roadmap forecast expenditure also has impacts on the GSI forecast.

AEMO's response to these capital expenditure adjustments is provided in the following sections.

Hardware and software lifecycle support project

The ERA's draft decision is to approve forecast expenditure of $60,000 for hardware and software lifecycle support for GSI however, it excludes the $19,000 (30%) contingency estimated for this work.

AEMO has reviewed the project, including contingency, and submits a contingency of $9,800 (22%) is required in total project forecast of $55,000.

Identity and access management project

The ERA's draft decision is to approve forecast expenditure of $56,000 for the Identity and Access Management project. This varies from the amount originally requested, however, it is in line with a revised forecast provided to the ERA of $168,000, of which $56,000 is the GSI component.

Digital roadmap

The scope, options and benefits of the 2019-20 AEMO-wide business system projects are articulated for WEM services in section 2.2.4, and equally apply to GSI.

AEMO maintains that the full GSI-related costs for the full three years ($828,000) should be approved. However, as per the discussion in section 2.2.4, the table below provides an overview of the GSI-specific forecast capital costs of the AEMO-wide business system projects that AEMO recommend the ERA approves as a minimum.

Table 8: GSI forecast capital expenditure on business systems 2019-20, ($,000 nominal)

Work stream	Pillar	Project	Forecast cost
Solution	Digital delivery	AEMO web digital enhancement	11
	Corporate systems	Design	16
	Enterprise capabilities	Enterprise architecture uplift	12
Data	Consumption	Enterprise data consumption tool foundation build	6
	Governance	Enterprise data governance framework	10

Work stream	Pillar	Project	Forecast cost
Compute	Platform infrastructure	Hybrid cloud detailed design and build	86
	Service management	Service management	34
Cyber security	NIST protect	Identity and access management	52
		Security awareness, training and culture	5
		Key controls	17
		Secure in design, dev and ops	8
	NIST detect & respond	Assurance, testing and exercise	16
		Threat detection and response	18
Total			291

Total GSI forecast capital expenditure

Taking the adjustments outlined above into consideration, AEMO submits total AR5 forecast capital expenditure for GSI is $1.186 million.

Table 9: GSI forecast total forecast capital expenditure for the AR5 period ($,000 nominal)

GSI capital project	AEMO proposed	ERA draft decision	AEMO response	Rationale / justification
Hardware and software lifecycle support project	79	60	55	AEMO estimates contingency of 22% is required for this project. Additional risk-based justification is provided in section 2.2.3. Note the allocation of costs to GSI in the initial submission was incorrectly calculated at 8%. The correct allocation is 6%.
Identity and access management project	91	56	56	The project is ahead of schedule during AR4, so the costs to be incurred during AR5 are lower than originally estimated. The original estimate also included some costs that were incorrectly attributed to WA. AEMO has since provided an updated forecast of $56,000 (GSI) for this work. AEMO estimates no contingency is required for this project.
Digital roadmap	1,104	-	828	AEMO has provided further information to justify investment in systems that relate to AEMO-wide business activities (i.e. not designed to deliver specific benefits to the WEM or NEM itself), which are scheduled to be delivered during the first year of the AR5 period. AEMO estimated contingency of 30% is required for this project. Note the allocation of digital roadmap costs to GSI in the initial submission was incorrectly calculated at 8%. The correct allocation is 6%.
Accommodation	-	-	247	Due to new IASB accounting standard for treatment of leasing costs.
Total GSI forecast capital expenditure	**1,273**	**116**	**1,186**	

A1. Responses to issues raised in public submissions

A1.1 Introduction

On 20 March 2019, the ERA published an issues paper[59] on AEMO's AR5 proposal. The ERA received eight public submissions, from the following stakeholders[60]:

- Australian Energy Council (AEC)
- Bluewaters Power
- Chamber of Commerce and Industry WA (CCIWA)
- Minister for Mines and Petroleum; Energy; Industrial Relations
- NewGen Power Kwinana Pty Ltd
- Perth Energy
- Synergy
- Western Power

Public submissions raised a variety of issues, many of which have been addressed in this response to the ERA's draft decision.

For convenience, this appendix provides a summary of some of the key issues raised by stakeholders, and how AEMO has responded to or addressed those issues.

A1.2 Key issues raised in public submission

A1.2.1 Three-year capital expenditure determination vs. a staged approach

In its issues paper, the ERA asked interested parties whether they preferred the ERA to approve funding:

- For the full three years of the AR5 period; or
- Through a staged approach where AEMO proposes additional funding as clarity and certainty develops through the market reform program.

[59] Available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations

[60] Public submissions are available at https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations

Six[61] of the eight submissions stated that they prefer a staged approach, while the Minister for Energy and Western Power expressed the importance of AEMO having sufficient funding to implement the WEM reform program, advocating multi-year approval.

It should be noted that there is general support for market reform from stakeholders, and they recognise the need for AEMO to incur significant capital expenditure to deliver those reforms. The key area of debate is the level of justification required for the ERA to be able to approve that expenditure forecast and whether it is prudent to approve the full forecast now.

As detailed in section 2.2.4 of its response to the AR5 draft decision, AEMO considers that approval of the full three-year capital expenditure forecast would result in the lowest practicably sustainable costs of delivering the WEM reform program. This is because funding certainty would put AEMO in a stronger position to be able to secure the necessary resources to deliver the WEM reforms at a more efficient cost. It would also ensure AEMO does not incur the avoidable costs of making an in-period forecast capex or allowable revenue adjustment submission.

The way the regulatory framework is designed means only capital expenditure actually incurred is recovered via allowable revenue (as depreciation costs in future periods). Market participants will only pay for services that are actually delivered. Approving a forecast capital expenditure amount for the full period does not commit AEMO to incurring the full capital forecast, and nor does AEMO have an incentive to do so (AEMO operates as a not-for-profit organisation and does not earn a return on a capital base).

Given the high profile of the WEM reform program and AEMO's commitment to ongoing transparent engagement with market participants on WEM reform projects, capital expenditure will be subject to external scrutiny throughout. AEMO will endeavour to implement the WEM reform program for the lowest practicably sustainable cost and will work with market participants to help achieve this.

AEMO therefore requests the ERA approves the full three-year capital expenditure forecast for WEM reform and uses the existing regulatory framework to adjust for actual costs during the AR6 period.

A1.2.2 Digital roadmap

A number of stakeholders raised concerns there was insufficient detail provided on the digital roadmap and the benefits the roadmap will deliver for WA.

As detailed in section 2.2.4 of its response to the AR5 draft decision, AEMO is endeavouring to provide additional information to the ERA on the digital roadmap, and will continue to refine the program scope during the AR5 period.

As with WEM reform, AEMO considers approving a full three-year capital forecast will result in the lowest practicably sustainable cost of providing services, as the funding certainty will enable AEMO to secure more resources at a more competitive price and avoid the cost of making in-period submissions. AEMO therefore maintains that the full $13.8 million forecast should be approved.

AEMO has, however, identified a number of business systems and applications that form part of the roadmap and are used by the whole of AEMO. These business systems, such as web services, cyber security and data management, are not specifically designed to deliver benefits to any specific market (e.g. WEM or GSI or NEM). They are shared by the whole of AEMO, and it would be impractical and inefficient for AEMO WA to have disparate corporate systems. AEMO therefore suggests that if the ERA considers it cannot approve the full three-year digital roadmap forecast at this time, the ERA approves, as a minimum, the forecast expenditure of ($4.8 million WEM and GSI) on business systems, which are scheduled for implementation in 2019-20.

[61] Noting that Bluewaters Power and NewGen Kwinana's submissions are duplicates of each other.

A1.2.3 Contingency

Stakeholders have queried AEMO's approach to calculating the contingency amounts included for each project in the capital expenditure forecast. While stakeholders do not suggest no contingency is required, they have requested that the ERA scrutinises the method AEMO has taken to develop the forecasts.

In section 2.2.1 of the response to the draft decision, AEMO has provided more information on its contingency approach, and has also reviewed the contingency allocation for each project based on the most up to date information on project scope, risk and resources. A project-by-project breakdown has been provided to the ERA. Contingency amounts range from 8% to 37% and are based on an assessment of specific project risks and the likelihood of those risks materialising.

A1.2.4 Provisions for rule changes

As noted by the ERA, at public forums stakeholders have expressed the view that AEMO should have a minimum provision in its allowable revenue and/or forecast capital expenditure for the development and implementation of business-as-usual rule changes. This view was reiterated by Perth Energy in its public submission.[62]

AEMO has therefore included $1.4 million in its capital expenditure forecast to account for business-as-usual rule changes that are not yet confirmed, but are likely to be required during the AR5 period. This forecast has been developed by reviewing existing information on known rule changes and making an informed judgement on what would be expected to proceed. The following sources have been used to inform the forecast:

- 'Open' rule changes on the Market Advisory Committee (MAC) website.[63]
- MAC Market Rules Issues List – last reviewed on 30 April 2019.[64]
- Pre-rule change proposals.

A1.2.5 WEM cost structure and allocation of market fees

Stakeholders raised concerns about the current cost structure in the WEM and the need to review fee allocations.[65] CCI WA states:

> *There needs to be a clearer delineation between the cost of designed and developing government policy and costs associated with the effective operation of the WEM. This could be achieved thought a review of fee allocations in the WEM, which would be appropriate considering the current and proposed reform programs of government will likely substantially change the cost structure of the WEM. Such a review could also help to address the issue of increasing fees on a per megawatt-hour basis to compensate for declining total operational consumption in the WEM.*[66]

AEMO accepts that the cost structure and fee allocations in the WEM would benefit from review, and is happy to work with market participants, government and energy sector stakeholders as part of a structured review. The question of WEM cost structures and allocations is, however, outside of the scope of the allowable revenue process.

[62] See Perth Energy public submission page 7, available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations

[63] https://www.erawa.com.au/rule-change-panel/market-rule-changes

[64] Available at: https://www.erawa.com.au/rule-change-panel/market-advisory-committee

[65] See public submission from AEC, CCI WA, Bluewaters and NewGen.

[66] See CCI public submission page 1, available at: https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations